THE
LOUISIANA
STATE
UNIVERSITY
LIBRARY

1860

BATON ROUGE

Digitized by the Internet Archive
in 2015

https://archive.org/details/louisianabulleti5015loui

African Violets for the Home

By 30

R. H. HANCHEY AND W. D. KIMBROUGH

An L.S.U. Seedling

BULLETIN NO. 501 FEBRUARY 1956

LOUISIANA STATE UNIVERSITY
and
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
J. N. Efferson, Director

LOUISIANA STATE UNIVERSITY LIBRARY

African Violets for the Home

R. H. HANCHEY AND W. D. KIMBROUGH

INTRODUCTION

Saintpaulia, although commonly called African violet, is no relation to the true violet, which belongs to the genus *Viola.* Saintpaulia is in the plant family Gesneriaceae, of which Gloxinia is a member. In this bulletin the terms Saintpaulia and African violet will be used synonomously.

The native habitat of Saintpaulia is the former German East Africa (Tanganyika territory). The plants were discovered in the latter part of the nineteenth century and given the name Saintpaulia by Wendlord, a German botanist. The generic name was given in honor of Baron Walter Von St. Paul, the father of the discoverer. Apparently seed of two distinct species were sent to Von St. Paul about the year 1890. These were *Saintpaulia ionantha* and *Saintpaulia diplotricha.* There are seven other known species at this time. They are *Saintpaulia tongwensis, Saintpaulia orbicularis, Saintpaulia magungensis, Saintpaulia grotei, Saintpaulia goetzeana, Saintpaulia pusilla,* and *Saintpaulia amaniensis.*

Saintpaulia ionantha has been responsible for practically all of the present day Saintpaulia varieties. Crosses between various species and varieties have been made at the Louisiana Agricultural Experiment Station. Selections of promising seedlings have been made and some of them are now being increased. *Saintpaulia goetzeana,* and *pusilla* are the only two known species that have not been used in breeding work at Louisiana State University.

African violets have become the most popular flowering house plant in America during the past decade. The African Violet Society of America, Inc. now has a membership of approximately 15,000, which is probably the largest of any plant society in this country. The popularity of African violets is due largely to the great number of varieties available to growers in a wide range of colors. The fact that blooms occur throughout the year and are not confined to a specific season, where plants are cared for properly, makes it a very desirable house plant. Although African violets are grown for their flowers, many varieties have such attractive foliage that they could compete with certain of the foliage house plants.

Many people would like to grow this plant but mistakenly think that it cannot be grown successfully in the South. The purpose of this bulletin is to discuss the culture of African violets for the home rather than for the greenhouse. Some of the recommendations are based on experimental results, others on observations.

1085

PROPAGATION

African violets can be propagated by leaf cuttings, stem cuttings, division, and seeds. The majority of those sold by florists have been propagated by leaf cuttings.

Propagation by Leaf Cuttings

In making leaf cuttings the entire leaf including the leaf stalk (petiole) should be removed from the parent plant. This can be accomplished by grasping the stalk near the crown between the thumb and forefinger and jerking to the side with a quick motion. The stalk should break at the base; otherwise the portion that is left may rot and possibly infect the parent plant. After the whole leaf is removed, the stalk should be cut leaving only one to two inches attached to the leaf blade for propagation. Practically any leaf on a growing plant except the youngest ones will easily form roots and small plants. The best leaves for propagation are the medium-sized ones near the center of the plant. Time of day or time of year does not affect the rooting of African violet leaf cuttings. The propagator can estimate six to nine months as the probable time of first flowers from plants grown from leaf cuttings. This varies considerably with varieties and cultural practices, with earlier or later blooming frequently occurring. Proper regulation of light influences time of bloom and will be treated later in this bulletin. After a cutting of the proper length has been made, it can be rooted in various types of media.

Rooting Media

Water—Many amateurs use water as a rooting medium. The first step in this method is to select a jar or glass and fill it with water. Wax paper or one of the plastic materials such as polyethelene is then placed over the mouth of the container and held in place by rubber bands or string. Holes large enough to allow penetration of the leaf stalks are then made. The leaf stalks are inserted through the holes in the paper and the lower part of the stalk is allowed to extend into the water. Within a few weeks roots appear at the base of the petiole and later small plants form at the base. Although this method is frequently used, there are better methods.

Soil—The use of soil as a rooting medium should be discouraged because of the danger of rot due to lack of oxygen caused by overwatering. Occasionally rotting of the petiole occurs from various fungi when the soil has not been sterilized.

A light soil that has been properly sterilized can, if watered correctly, be used satisfactorily as a rooting medium.

Sand—Coarse sand can be used as a rooting medium. A mixture of one-half sand and one-half peat by volume can also be used.

Sponge-Rok—This material, although highly advertised as an African violet rooting medium, has not proved satisfactory in tests conducted at this Station. Root initiation occurred, but newly formed roots developed a discoloration and the mortality of plants was high before and after transplanting.

Vermiculite—The agricultural grade of vermiculite has been the best material used at Louisiana State University for propagating African violets by leaf cuttings.

Packing and overwatering of vermiculite should be avoided as this is usually the direct cause for poor results in rooting cuttings when this material is used.

A mixture of one-half each of vermiculite and sand by volume is also a good rooting medium.

Handling of the Cutting

Semi-mature leaves should be selected from healthy plants and removed with one to two inches of petiole attached. The rooting medium should be at least 3 inches in depth and well drained. The propagating box or bed should be in a shaded place, such as in a garage or on a back porch. The medium should be watered well before the cuttings are placed in it. After the medium is watered the basal end of the leaf petiole should be dipped in one of the commercial root-inducing materials. The weakest preparation sold should be used. The leaf cuttings should then be inserted 1 to 1½ inches deep in the rooting medium. They should be standing erect after placement in the rooting medium and they can be spaced very close together. Usually one-half to one inch is sufficient spacing. After the cuttings are properly placed, they should be watered to settle the medium around the base of the cutting. If vermiculite is used, it should never be packed. Tepid water or water of approximately the same temperature as that of the surrounding air should be used. This prevents discoloration of leaves. Cuttings placed in vermiculite usually root in 21 to 30 days. Small plants usually appear 30 to 60 days after roots form. The rooted leaf can either be left in the rooting medium until small plants form or be placed directly into pots containing the proper mixture. In many respects the latter method is preferable. When the young plants have developed four to six leaves they should be divided and shifted to 2½-inch pots. If the young plants are left attached to the petiole without division they become crowded and result in unsatisfactory plants. They should be removed from the small pots and placed in 4-inch pots after 60 to 90 days. Four-inch azalea pots are excellent for African violets.

Propagation by Stem Cuttings

The apical portion of single- or many-crowned plants can be severed and rooted in any of the media used for leaf cuttings. This method of propagation assures large plants in a shorter length of time than can be obtained from leaf cuttings, but the number of plants obtained per plant is greatly reduced.

Propagation by Division

After a plant becomes old and several individual crowns have formed they may be divided and placed in separate pots. When handled properly these divisions bloom better than when crowded in one container.

Propagation by Seed

Propagation by seed is usually done by the plant breeder and hybridizer. Plants from seed are never exactly like the parent plant. Thus most amateurs do not practice this type of propagation. Most of the present day varieties originated from seed. Usually self-pollination does not occur in this plant. Thrips may carry pollen from the anthers of one flower to the stigma of another and pollinate it. If thrips are controlled, pollination may be accomplished by transfer of pollen from the desired male parent to the desired female parent, without bagging the pollinated flower.

Saintpaulia seed are very small and one seed pod may contain thousands of seed. These seed can be germinated satisfactorily in a shallow box or seed flat that has openings in the bottom for drainage. Place shredded sphagnum moss one to two inches deep in the seed box and soak thoroughly with water. Mix the seed with sand and scatter over the surface of the sphagnum moss. The seed are too small to cover and will germinate readily when sown in this manner. A pane of glass should be placed on top of the seed box so that a very high relative humidity will be maintained. The container should then be placed in a shaded place until germination. The seedlings are very small and require careful handling. When the small seedlings are large enough to be "pricked off" with tweezers they can be transplanted into flats containing a good potting mixture and later shifted to pots. They can also be taken directly from the seed flat and placed in 2-inch pots and then be shifted to 4-inch pots when needed.

POTTING MIXTURE AND POTTING

A mixture, by volume, of one part soil, one part sand, one part peat, and one part of well rotted manure makes a very good growing medium for African violets. Two parts soil, two parts peat, and one part sand is also a good mixture. Whatever the mixture used, it should contain a high percentage of organic matter to enable proper root growth.

The bottom of the 4-inch azalea pot should be covered with broken pottery or rocks to insure drainage. If the pots are new they should be soaked in water 12 hours prior to using. The plant with ball of soil attached should be placed approximately the same depth in the 4-inch pot as it was prior to shifting. One-half inch of space should be allowed at the top of the pot after potting to make watering easier.

FACTORS INFLUENCING GROWTH AND FLOWERING

The major factors that affect growth and flowering of African violets are the proper amounts of light, temperature, and water. These factors are closely associated but will be treated separately.

Light

In general the intensity of light is measured as foot-candles. On a bright summer day at noon the peak light intensity is usually around 10,000 foot-candles in the Midwestern states. The more expensive light meters will record up to 10,000 foot-candles.[1] In Louisiana the light intensity outdoors at noon over a large portion of the year exceeds this figure. The intensity of sunlight is subject to fluctuations and varies from hour to hour, day to day, and season to season. The intensity reaching the earth's surface is influenced by clouds, fog, dust, and atmospheric humidity.

Proper regulation of light is necessary for good flowering of this plant. The results in Table 2 show that vegetative growth can be made at a very low light intensity.[2] An intensity of 100 foot-candles of light of 12 hours duration is sufficient to produce a healthy plant of good form and foliage color but insufficient for any appreciable flower production. It is apparent from the results in Table 2 that around 1,100 foot-candles of natural light for as great a part of the day as possible was best for both vegetative growth and flowering of African violets. It is also apparent from data presented in Tables 1 and 2 that earlier and more flowering can be obtained by the use of fluorescent light of 600 f.c. intensity for 12 to 18 hours per day. This is due primarily to the uniform intensity maintained under fluorescent light.

---

[1] A light meter manufactured by the General Electric Company, Lamp Department, Nela Park, Cleveland 12, Ohio, can be obtained at a reasonable cost. The Model number is 8 DW 40-Y16. The recent price of this article was $12.00 plus $1.50 for the carrying case and includes a 10 to 1 shield which, when attached to the meter, allows a reading of 1,000 foot-candles. A second shield to give a 10,000 foot-candle reading may be obtained for fifty cents.

[2] The data presented in Tables 1 through 5 were taken from experimental work done in the Floriculture Department of the Ohio State University, Columbus, Ohio.

Fluorescent Light

Daylight fluorescent lamps of 40 - 85 watts suspended at the proper level over plants in the home can furnish sufficient light for earlier flowering than can ordinarily be obtained in the home from natural light. Two 85-watt daylight fluorescent tubes suspended 12 inches above the plants will furnish 600 foot-candles of light. If a time clock is installed it can be set for the desired time of exposure.

TABLE 1.—Time required for open flowers to appear in leaf axils tagged October 10, on plants growing under various light treatments[1]

Treatment	Average Date of First Flower	No. of Plants Flowering[2]
FLUORESCENT LIGHT—BASEMENT		
100 f.c.[3] 6 hours		0
100 f.c. 12 hours	January 20	2
100 f.c. 18 hours	February 26	2
300 f.c. 6 hours	January 20	5
300 f.c. 12 hours	January 17	5
300 f.c. 18 hours	January 15	5
600 f.c. 6 hours	January 25	3
600 f.c. 12 hours	January 2	5
600 f.c. 18 hours	December 28	5
NATURAL LIGHT—GREENHOUSE		
300 f.c.[4] adjusted shade	January 29	5
300 f.c.[5] fixed shade	March 4	5
500 f.c. adjusted shade	January 26	5
500 f.c. fixed shade	February 18	5
700 f.c. adjusted shade	January 27	5
700 f.c. fixed shade	February 3	5
900 f.c. adjusted shade	January 25	5
900 f.c. fixed shade	February 8	5
1100 f.c. adjusted shade	January 26	5
1100 f.c. fixed shade	February 12	5
1300 f.c. adjusted shade	January 26	5
1300 f.c. fixed shade	February 11	5

[1] The smallest leaf on each plant was tagged October 10 1951.

[2] Five plants used per treatment.

[3] Foot-candles.

[4] Adjusted shade. This refers to treatments where the specified light intensity was maintained throughout the entire day insofar as possible by manipulating the cloth covering the plots at two-hour intervals after light readings were taken.

[5] Fixed shade. This refers to treatments where the specified light intensity was reached most days at the peak of natural light intensity during the day, and cloth covering prevented the specified intensity from being reached.

Twelve hours of light of 600 foot-candles intensity is an ample amount for good flowering.

TABLE 2.—Number of flower stalks, flowers per flower stalk, flowers per plant, average spread of plant, number of leaves, and number of crowns per plant produced under daylight fluorescent light of controlled intensity and duration, and under natural light of varying intensity and duration from September 6, 1951 to February 6, 1952*

Treatment	Average No. of Flower Stalks Per Plant	Average No. of Flowers Per Flower Stalk	Average No. of Flowers Per Plant	Average Spread of Plant (in inches)	Average No. of Leaves Per Plant	Average No. of Crowns Per Plant
FLUORESCENT LIGHT—BASEMENT						
100 f.c. 6 hours	1.6	1.81	2.9	9.9	22.3	1.2
100 f.c. 12 hours	9.5	3.75	35.6	13.6	27.3	1.1
100 f.c. 18 hours	8.1	4.55	36.9	14.5	34.8	1.5
300 f.c. 6 hours	10.4	3.28	34.1	12.0	28.7	1.2
300 f.c. 12 hours	18.0	4.87	87.7	15.0	42.4	1.8
300 f.c. 18 hours	17.4	6.38	111.0	13.4	52.3	2.4
600 f.c. 6 hours	18.9	4.86	91.9	14.4	44.6	1.7
600 f.c. 12 hours	22.6	8.00	180.8	14.2	54.3	2.4
600 f.c. 18 hours	28.3	8.46	239.3	13.3	55.7	2.5
NATURAL LIGHT—GREENHOUSE						
300 f.c. adjusted shade	17.9	5.27	94.3	12.0	44.0	2.3
300 f.c. fixed shade	15.9	4.40	69.9	12.5	60.6	3.1
500 f.c. adjusted shade	20.6	5.07	104.4	11.8	63.0	3.7
500 f.c. fixed shade	18.4	5.19	95.5	12.0	53.6	2.6
700 f.c. adjusted shade	23.2	5.47	126.9	11.4	77.5	3.7
700 f.c. fixed shade	23.2	4.89	113.4	12.0	66.5	3.1
900 f.c. adjusted shade	21.7	5.55	120.5	10.4	65.8	3.2
900 f.c. fixed shade	23.8	5.08	120.8	11.0	65.8	3.1
1100 f.c. adjusted shade	23.4	5.58	130.5	10.4	87.5	4.4
1100 f.c. fixed shade	26.1	5.46	142.6	10.6	72.5	3.6
1300 f.c. adjusted shade	24.5	5.59	136.9	10.3	81.9	3.6
1300 f.c. fixed shade	30.4	5.87	178.5	10.8	78.2	3.8

* Ten plants per treatment.

The data in Tables 1 and 2 show that in addition to earlier flowers more flowers can be produced under daylight fluorescent light of 12 and 18 hours duration than can be produced under a wide range of fluctuating natural light intensities. Another advantage of daylight fluorescent light over natural light is that as many as two flower stalks can be produced in a single leaf axil, whereas under natural light one flower stalk per leaf axil is the general occurrence.

The results presented in Tables 3, 4, and 5 show that 600 foot-candles of fluorescent light is more efficient in actual initiation of floral parts at 6, 12, and 18 hours duration than either 100 or 300 foot-candles. Tables 1 and 2 show that the same treatment is more conducive to earlier development of flower parts and more flowers per flower stalk.

The upper surface of leaves of plants grown under daylight fluorescent light is darker green in color than when grown under natural light. The under surface of the leaves is usually a dark red color and very attractive.

TABLE 3.—The effect of fluorescent light for 6 hours duration per day at 3 intensities on floral initiation of Saintpaulia, in leaf axils marked October 10, 1951

Light Intensity	Plant Number	Sampling Dates, 1951						
		Oct. 17	Oct. 25	Oct. 31	Nov. 7	Nov. 14	Nov. 21	Nov. 28
100 f.c.								
	1	V	V	N	N	N	V	V
	2	V	V	N	N	N	V	V
	3	V	V	N	N	N	V	V
	4	V	V	N	N	N	V	V
	5	V	V	N	N	N	V	V
300 f.c.								
	1	V	V	V	R	R	R	V
	2	V	V	V	R	R	R	-
	3	V	V	V	R	V	R	R
	4	V	V	V	R	R	R	R
	5	V	V	R	-	R	-	R
600 f.c.								
	1	V	R	V	R	R	R	R
	2	V	V	V	R	R	R	R
	3	V	V	V	R	R	R	R
	4	V	V	V	R	R	R	R
	5	V	R	R	R	R	R	R

V—Axillary meristem still in vegetative stage.
R—Axillary meristem had reached reproductive stage.
N—Leaf axil sample not sectioned.

Growing of African violets in dark rooms, basements, and cellars is made easy by the use of artificial light, and daylight fluorescent lamps are excellent for this purpose.

Natural Light

Natural light of adequate intensity to induce flowering in African violets is difficult to obtain in many homes. Even when the proper intensity can be obtained, the duration is frequently not of sufficient length to insure best flowering of the plants. African violets should never be exposed to light intensities exceeding 1,300 foot-candles for any length of time. Intensities higher than this cause the plants to turn a light green color and the leaves to become small, crinkled, and like leather to the touch. Best results in flowering can be expected where the light intensity is around 1,000 to 1,100 foot-candles for at least seven hours per day. Good results can be obtained at lower intensities of shorter duration. The plants should be placed where they will be exposed to direct light during the very early morning hours when the intensity isn't too high. East windows and porches are excellent locations. West and south

TABLE 4.—The effect of fluorescent light for 12 hours duration per day at 3 intensities on floral initiation of Saintpaulia, in leaf axils marked October 10, 1951

Light Intensity	Plant Number	Sampling Dates, 1951						
		Oct. 17	Oct. 25	Oct. 31	Nov. 7	Nov. 14	Nov. 21	Nov. 28
100 f.c.								
	1	V	V	V	-	R	R	-
	2	V	V	R	V	R	R	-
	3	V	V	V	R	R	R	R
	4	V	V	R	R	V	V	R
	5	V	R	V	-	V	R	-
300 f.c.								
	1	V	V	V	V	R	R	R
	2	R	V	V	R	R	R	R
	3	-	V	V	V	V	-	V
	4	V	V	R	V	R	R	R
	5	V	R	V	R	R	-	-
600 f.c.								
	1	R	V	R	R	R	R	R
	2	V	R	R	R	R	R	R
	3	R	V	V	R	R	R	V
	4	V	R	R	R	R	R	R
	5	V	-	V	R	R	R	-

V—Axillary meristem still in vegetative stage.
R—Axillary meristem had reached reproductive stage.
N—Leaf axil sample not sectioned.

TABLE 5.—The effect of fluorescent light for 18 hours duration per day at 3 intensities on floral initiation of Saintpaulia in leaf axils marked October 10, 1951

Light Intensity	Plant Number	Sampling Dates, 1951						
		Oct. 17	Oct. 25	Oct. 31	Nov. 7	Nov. 14	Nov. 21	Nov. 28
100 f.c.								
	1	V	V	V	V	R	-	V
	2	V	V	V	V	V	R	V
	3	V	V	R	V	V	V	V
	4	V	V	V	R	V	V	R
	5	V	V	V	V	V	V	V
300 f.c.								
	1	V	V	V	V	R	-	R
	2	V	R	V	R	R	R	R
	3	V	V	R	V	R	R	R
	4	V	R	V	R	R	R	R
	5	-	V	V	R	R	R	R
600 f.c.								
	1	V	V	V	V	R	R	R
	2	V	V	R	R	R	R	R
	3	V	R	R	R	V	R	R
	4	V	R	R	R	R	-	R
	5	V	R	V	R	R	-	R

V—Axillary meristem still in vegetative stage.
R—Axillary meristem had reached reproductive stage.
N—Leaf axil sample not sectioned.

windows are satisfactory if blinds and curtains can be used to protect the plants from the direct sun.

Plants that produce dark green leaves with long petioles are usually found growing where sufficient light is lacking. If the leaves are bleached, small, and like leather and the petioles are very short, the chances are too much light is present.

Water

Many methods of watering have been recommended for African violets. Among these are wick watering, constant water level, saucer watering, and various modifications of these.

Most African violet growers will find overhead watering to be the safest, simplest, and most effective method to use. In watering these plants, make certain that the water isn't cold but is approximately the temperature of the room where the plants are growing. Water that is too cold can cause discoloration of the leaves, if it comes in contact with them. Water in a jar or other container left in the room several hours with the plants should be the correct temperature to use. Mixing water from the cold and hot faucet is a satisfactory way to obtain water of the proper temperature. A saucer placed under the pot containing the plant will catch the excess water that drains through at the time of watering.

Chlorinated or fluorinated water, if satisfactory for human consumption, is satisfactory for African violets. Rain water would be ideal but few have access to it for long periods of time.

When watering plants, give them a thorough soaking and then wait until the potting mixture becomes slightly dry before watering again. Plants may need watering any time from one to four days after a watering depending on the temperature and humidity where they are growing. Plants need not be watered as frequently where the humidity is high as where it is low. High temperature over a prolonged period of time will mean frequent watering will be necessary.

Temperature

The ideal temperature for growing African violets is around 60-65° F. at night and 70-75° F. during the day. Plants at the Louisiana Agricultural Experiment Station have made good vegetative growth and flowered profusely at day temperatures up to 100° F. The size of flower was not materially reduced when compared with plants growing at nearer the optimum temperature. Flowers of Mentor Boy, Red King, and other varieties had white streaks which were due to the high temperature. The leaves were slightly smaller than average for the varieties used. The smallness of leaves was probably due to high temperature and a higher than optimum light intensity.

A high temperature combined with low humidity is more harmful than a combination of high humidity and high temperature for growing these plants.

Where the relative humidity is maintained around 60 - 70 per cent and the temperature from 60 - 70° F. excellent growth and flowering can be expected if the light intensity and other factors are satisfactory. One of the reasons why many amateurs grow good African violets in their kitchens is because of the high humidity usually present from escaping steam from the kitchen stove. In many instances kitchens are on the east side of the house, thus insuring morning light to the plants on the kitchen window ledge.

The temperature should never be allowed to drop below 50° F., as the plants are more subject to mildew at a low temperature and will not grow as well.

FERTILIZERS

If the potting mixture is deficient in any of the major mineral elements, a complete fertilizer applied properly is beneficial.

This can be applied in dry or liquid form. Any of the commercial preparations should be satisfactory. Never apply more often, or in larger amounts, than recommended on the bottle or package. In fact, one-half to two-thirds the recommended amount is usually sufficient.

If liquid fertilizer is used, usually one to two months between applications is satisfactory. If a dry fertilizer is used, three to five months between applications is usually often enough.

The optimum fertilizer levels for best growing and flowering of African violets is nitrate 10 - 25 ppm, phosphorus 5 ppm, potassium 20 ppm, and calcium 150 ppm. These levels are based on the Spurway System of soil testing. It is easy to damage pot plants with fertilizer, and special care should be used to prevent injury.

VARIETIES

The African violet grower has many varieties from which to select. These range in flower form from single to double. Varieties producing flowers that are white, blue, reddish, pink, purple, mottled, and blotched may be obtained. There is as yet no yellow variety. Varieties differ greatly in leaf shape. New varieties are constantly appearing in the trade. Some are good while others are inferior. The practice some breeders have of selling inferior seedlings to individuals should be discouraged, as the seedlings are frequently named and sold by the buyer or given to other growers. Only a short time is needed before they have been passed on to many growers. Actually a large percentage of the varieties available on the market are worthwhile only to collectors. For the average grower only those varieties that are easy to grow and that flower readily should be purchased.

The varieties in the following list have done well in the Louisiana Agricultural Experiment Station greenhouses and can be recommended to the home grower. There are many other excellent varieties available to the grower that are not listed here.

DOUBLE VARIETIES

White

Purity—excellent
White Madonna—excellent
Fishers Alma Wright—excellent

Blue

Double Neptune—excellent

Light Blue

Corsage—very good

SINGLE VARIETIES

Dark Blues and Purples

Purple Prince—excellent
Blue Boy—excellent
Blue Fairytale—excellent
Purple Night—excellent
Ulreys Blue Girl—excellent
Blue Ohio—very good
Jersey Giant—very good
Mentor Boy—very good
Hybrid Blue Girl—very good
Neptune—very good
Lady Geneva—good
Blue Bird—good

Reddish

Redhead—excellent
Sunrise—excellent
Red Mentor—excellent
Hybrid Red Girl—excellent
Red King—very good

Lavender

Opal Girl—excellent
Orchid Beauty—very good
Amethyst—good

Medium Blue

Myrtle—very good
Dupont Blue—good
Mermaid—good

Light Blue

Sailor Girl—excellent
Ionantha—very good
Sailor Boy—good

Pink

All Aglow—good
Pink Delight—good
Pink Attraction—good
Pink Supreme—good
Shocking—good
Pink Beauty—good

White

Innocence—excellent
Snow Girl—excellent
Snow Prince—very good

Certain varieties such as Star Girl, Painted Lady, Easter Egg, Frosty, and Fantasy are excellent but the color of flower is not stable. Many of the inflorescences revert to solid colors.

Apple Blossom and Ruffled Queen are two excellent varieties for the beginner. Moonlight has very attractive foliage but is difficult for the amateur to grow.

DISEASES, INSECTS, PESTS, AND PHYSIOLOGICAL PROBLEMS

Mildew

This disease is caused by a fungus. The first symptoms appear as whitish patches of growth on the leaves. It can be controlled by dusting with a fine grade of sulphur or by spraying with one teaspoonful of wettable sulphur to one gallon of water. This fungus is more troublesome when the temperature is low.

Stem Rot

Usually caused by various fungi. Sterilization of soil prior to potting helps prevent this. Proper watering and good drainage also help. These fungi thrive under waterlogged conditions.

Stunt

This disease is caused by a virus. The symptoms are thickened, brittle, light-colored leaves on the new growth. The leaves have a tendency to curve downward. Infected plants should be destroyed, as there is no control for this trouble.

Petiole Rot

The leaf petiole frequently rots when it touches the pot in which the plant is growing. When this occurs it is usually due to an accumulation of fertilizer salts at the point of contact. This occurs more often when plants are watered from below.

Preventive measures are overhead watering and proper fertilizing practices. Tinfoil or scotch tape covering the rim of the pot will reduce this rot.

Excess Fertilizer

The addition of too much nitrogen may cause wilting of the plant and a burning of the foliage. Excess potassium can also cause a browning of the leaf margins. Where excess nitrogen is used, the root system is greatly restricted. If excess fertilizer is applied, the plants should be watered thoroughly several times to leach the material from the soil.

Bud Drop

The dropping of buds may be due to extreme changes in temperature, overfertilization, thrip infestation, overwatering, and a very low humidity.

Mites

These pests are very small, being invisible to the naked eye.

The usual symptom of mite injury is a curling and dwarfing of young leaves. The leaves usually curl upward. Flowers may become streaked and small. Flower stalks may swell and curve or flatten out.

Mites may be controlled by spraying the plants with two teaspoons of malathion per gallon of water.

Thrips

These insects cause bud drop and also pollinate flowers, thus causing seed formation. They are harmful to both foliage and flowers.

Lindane, D.D.T., and malathion may be used to control thrips. Malathion will cause spotting of the open flowers when it comes in contact with them. These insecticides should be used at the following rates: 1 teaspoon of Lindane per gallon of water; 2 teaspoons of malathion or D.D.T. per gallon of water. Use either of the above as a spray.

Mealybugs

These pests can cause a lot of trouble on African violets by sucking the plant juices and causing malformed leaves and flower stalks.

Malathion will usually control mealybugs. Use as a spray at the rate of 5 teaspoons per gallon of water. Rubbing alcohol placed on a cotton-covered stick and rubbed on the pest will also kill it, although this is a slow process.

Aphids

Aphids or plant lice can be controlled with nicotine sulphate or with malathion. Use malathion at the rate of 2 teaspoons per gallon of water.

Nematodes

These tiny eel worms are usually present in the soil. The best control is soil sterilization prior to potting the plant.

SUGGESTIONS FOR GROWING AFRICAN VIOLETS

1. Obtain varieties that flower well.
2. Pot plants in a mixture that has a high organic content and that drains well.
3. Avoid placing the plants in full sun.
4. Water plants correctly; use warm water, and do not overwater.
5. Grow plants where the humidity is as high as possible.
6. Avoid drafts.
7. Never wet the foliage with cold water.
8. When needed, the application of fertilizer should be beneficial, but excessive amounts will easily cause injury.
9. The plant should be in the light for as great a length of time as possible during the day but the light intensity should not exceed 1,300 foot-candles.
10. Use fluorescent lights in locations that do not have sufficient natural light.
11. Control insects, pests, and diseases.

630.1
L93b
#502

Beef Cattle Research

At the West Louisiana Experiment Station, 1951 - 55

By A. H. McDaniel

Bulletin No. 502

February 1956

Agricultural Experiment Station
J. N. Efferson, Director

Louisiana State University
and
Agricultural and Mechanical College

CONTENTS

Page

INTRODUCTION 5
  Herd Management 5
  Cows Used in Studies 6
  Bulls Used in Studies 6

EARLY GRAZING STUDIES 8
  Procedure 9
  Results 9

SHADE STUDIES 10
  Procedure 11
  Results 14

BREED COMPARISON 16
  Score or Grade 16
  Disposition 16
  Weight Comparisons 17
  Performance on Pasture 17
  Wintering Ability 17
  Calving Per Cent and Per Cent Calf Crop 17
  Birth Weights 19
  Gestation Periods 19
  Weaning Weights and Gains 20
  Production per Cow 21
  Medical Attention and Death Loss 21
MINERAL STUDIES 21
  Procedure and Results 22

SUMMARY 24

LITERATURE CITED 27

Beef Cattle Research at the West Louisiana Experiment Station

1951-55

By A. H. McDaniel*

INTRODUCTION

Experiments reported here were initiated in 1951 and completed in 1955. These studies were conducted with Hereford and Aberdeen-Angus cattle and were designed for the following purposes:

1. To determine the number of hours per day that cattle should have access to improved pasture in order to meet their full grazing needs for maximum gains.
2. To determine the relative value of different types of shade for Hereford and Angus cattle when grazing improved pastures.
3. To compare the Hereford and Aberdeen-Angus breeds when grazing improved pastures.
4. To determine the relative amounts of phosphorus, calcium, and salt consumed by cattle when grazing improved pastures and native range land.

These problems were studied in response to questions from farmers and cattlemen in Louisiana who are showing increased interest in beef cattle production on improved pastures.

The studies were made at the West Louisiana Experiment Station, which is located in the cutover pine lands of West Louisiana.

Herd Management

All cattle were carried on improved pastures from early spring until about the middle of November. During the winter the cattle were placed on wooded, range pastures and fed 1.5 pounds of cottonseed cake and 18-20 pounds of legume-grass mixed hay per day. The improved pastures were planted largely to white and crimson clover, fescue and rye grass, Singletary peas, Dallis grass, and common and Coastal Bermuda. Cattle were weighed at the end of each month and, if on improved pastures, were rotated from pasture to pasture in an effort to eliminate pasture differences. Animals were sprayed when needed to control horn flies and lice, and were treated periodically for internal parasites. All cattle were Bang's tested annually, and the herd remained free of Bang's throughout the test.

All cattle were permanently identified with neck chains, horn brands, or body brands.

---

*Assistant Animal Husbandman, West Louisiana Experiment Station.

Cattle were Bang's tested and wormed at the same operation.

The breeding season started January 1 each year and continued through May. This resulted in calves being dropped from early October through the winter months. It was desirable to have the calves dropped during the fall and winter months in order to take full advantage of the early spring grazing. This also eliminated the necessity of milking the surplus in some cows of both breeds. The early summer markets were usually the best and it was advantageous to have the calves separated from the cows during the hot dry part of the summer and fall. However, the heifer calves that were kept for replacements were usually left with their mothers until about the 15th of August. The calves were not creep fed.

Cows Used in the Studies

Data for the studies were collected from approximately 75 head of registered and grade Hereford and Angus cows with calves each year. The grade cattle were purchased in Texas, Louisiana, and Oklahoma. The Hereford breed made up approximately 55 per cent of the cattle used. Angus comprised the remainder. Registered Hereford and Angus cattle made up 21 per cent of the cattle used in the studies. These cows were purchased from well-known Texas breeders. The grade Hereford and Angus cattle used were of high quality and were representative of the breeds.

Bulls Used in Studies

All hereford and Angus bulls used were registered. Four Hereford and three Angus bulls were used extensively during the 5-year study.

Bulls were selected primarily on type with some emphasis on size, but no effort was made to keep the size of the Hereford and Angus bulls comparable. This resulted in a 5-year average weight advantage of 344 pounds in favor of the Hereford bulls. The average monthly weight of

Part of the grade Herefords that were used in the studies, July 1952.

Part of the grade Angus that were used in the studies, July 1952.

Young bulls that were born and reared at the West Louisiana Experiment Station.

the Hereford bulls during the 5-year period was 1,682 pounds, whereas the Angus bulls averaged 1,338 pounds. The bulls were given a generous allowance of grain, protein supplement, and hay during the winter months or breeding period, but received no supplement during the remainder of the grazing period. They were kept in the same relative condition as the cow herd.

Hereford Bulls

Name	*Registration Number*	*Average Weight*
L.S.U. Rupert 14	5514005	1,618
M. W. Anxiety 52	3743117	1,655
L.S.U. Baca Duke	6282310	1,657
C. K. Cascade 64	5558024	1,797

Angus Bulls

Name	*Registration Number*	*Average Weight*
Prince 7 of L.S.U.	1168178	1,280
Proud Prince 10 of L.S.U.	1348679	1,309
Prince 12 of L.S.U.	1274531	1,424

EARLY GRAZING STUDIES

This study was initiated in 1951 in an effort to learn more about the grazing habits of beef cattle while grazing improved pastures. Farmers and stockmen often find a need for part-time grazing because of excessively wet or boggy pastures or the occurrence of bloat. It was therefore desirable to know the number of hours in a day that beef cattle of various age classes should be left on highly improved pastures in order to meet their full grazing needs for maximum gains or production.

Procedure

The study covered a 4-year period and the data were collected from 24 test groups of cows, 18 test groups of yearling heifers, and 19 test groups of calves involving 152, 159, and 101 head of cows, yearlings, and calves respectively. The average numbers of cows, yearlings, and calves per test were 7, 9, and 5 head respectively. The test periods averaged 24 days in length. The collection of data was begun each year as soon as grazing was available and continued until the influence of temperature on the grazing habits was noticeable. Cattle were observed to start seeking shade about the 15th of April.

The cattle on the tests were observed hourly from 6 A.M to 6 P.M. (12 hours), and the time spent grazing, standing, and lying was calculated.

Results

The results in Table 1 are averages for the 4 years during which the study was conducted. The breeds are treated separately in the table. The time spent grazing during the 12-hour observation period for the Hereford cows, yearling heifers, and calves was 5 hours 9 minutes, 4 hours 44 minutes, and 3 hours 28 minutes respectively.

The corresponding information for the Angus cows, yearling heifers, and calves was 5 hours 41 minutes, 5 hours, and 4 hours 4 minutes respectively. No significant differences were found between breeds for

TABLE 1.—Performance and grazing habits of Hereford and Aberdeen-Angus cattle when grazing early improved pastures

(4-year summary, 1951-1954)

Class	Cows		Heifer Yearlings		Calves	
Breed	Hereford	Angus	Hereford	Angus	Hereford	Angus
Number of animals	96	56	106	53	67	34
Av. weight (lb.)	890	850	552	562	208	210
Av. daily gain (lb.)	3.53**	2.45	2.53	2.41	2.40	2.41
Grazing habits (6 A.M. to 6 P.M.)						
Grazing (hr. and min.)	5 hr. 9 min.	5 hr. 41 min.	4 hr. 44 min.	5 hr.	3 hr. 28 min.	4 hr. 4 min.
Standing (hr. and min.)	3 hr. 51 min.	3 hr. 40 min.	3 hr. 36 min.	3 hr. 23 min.	3 hr. 37 min.	3 hr. 22 min.
Lying (hr. and min.)	3 hr.	2 hr. 39 min.	3 hr. 40 min.	3 hr. 37 min.	4 hr. 55 min.	4 hr. 34 min.
Number of tests	13	11	13	5	11	8
Av. days on test	24.0	22.0	18.7	29.8	25.1	24.9
Av. number per test	7.4	5.1	8.2	10.6	6.1	4 3
Av. max. temp. (deg. F.)	71.9	70.6	76.5	78.0	71.2	69.4

**Significant at probability of 0.01.

cows, yearling heifers, or calves in grazing habits during the early grazing period.. Hereford cows, however, made significantly greater gains during the early grazing period than did the Angus cows. This difference was not observed between the yearling heifers and calves of the two breeds.

SHADE STUDIES

The effect of shade is known to vary with climatic conditions. The importance of the type or kind of shade is also becoming increasingly apparent. Worstell and Brody (1953) have suggested that there is more urgent need for developing methods for protecting cattle against rising temperatures above 80° F. than against declining temperatures below freezing. Experiments conducted by the Mississippi Agricultural Experiment Station (1953) showed that yearling Angus steers grazing pastures with natural or artificial shade in July and August made better gains than steers on pastures without shade. However, in work conducted by the Oklahoma Agricultural Experiment Station (1954), it was found that artificial shade had little apparent effect on either Hereford cows or calves. Kelly (1949) and Ittner (1951) in California found the type or kind of artificial shade, with reference to shade height and kind of roof, had a decided effect upon lowering the radiant heat load on the animals standing in the shade.

The tests reported here were conducted to compare the performance and grazing habits of Hereford and Angus cows and calves grazing improved pastures with different types of shade, including pastures without shade.

Cattle made good use of scanty natural shade.

grazing improved pastures with different types of shade, including pastures completely without shade.

Procedure

This study covered a 4-year period beginning in 1951 and continuing through 1954. Data for the study were collected from 81 test groups involving approximately 75 head of registered and grade Hereford and Angus cows with calves each year. Information on cattle grazing in pastures with shade was collected from 61 test groups, whereas 20 test groups comprised the source of information for cattle grazing the patures completely without shade. The test periods averaged 25 days in length and the average number of cattle per test was 6 cows with calves. The collection of data was begun each year as soon as visual symptoms of climatic stress were evident. These symptoms were usually noticeable about the 15th of April and continued through the summer months.

The treatments consisted of pastures with (1) abundant natural shade, (2) scanty natural shade, (3) artificial shade, and (4) no shade. The abundant natural shade was made up of areas or groups of trees consisting predominantly of gum, oak, and bay. The scanty natural shade consisted of scattered pine trees and pine saplings, and some small oak trees. The artificial shades had roofs of hay, straw, or pasture clippings and were 12 feet by 24 feet and 7 feet above the ground. The roofs on the artificial shade were approximately 6 inches thick supported by net wire.

The type of artificial shade used in these studies was 12 x 24 feet and 7 feet above the ground.

TABLE 2.—Effects of type of shade on performance and grazing habits of Hereford and Aberdeen-Angus cows

(4-year summary, 1951-1954)

Treatment	Abundant Natural Shade		Scanty Natural Shade		Artificial Shade		Without Shade	
Breed	Hereford	Angus	Hereford	Angus	Hereford	Angus	Hereford	Angus
Number of cows	157	98	55	55	18	22	77	35
Average weight (lb.)	1045	962	1058	1016	1014	969	1013	926
Average daily gain (lb.)	1.19*	1.43*	1.10	.90*	.70	.95*	.13	—.44
Grazing habits (6 A.M.-7 P.M.)								
Grazing (hours and minutes)	4 hr. 12 min.	4 hr. 23 min.	4 hr. 29 min.	3 hr. 56 min.	4 hr. 7 min.	3 hr. 50 min.	4 hr. 5 min.	3 hr. 7 min.
Standing (hours and minutes)	4 hr. 18 min.**	4 hr. 13 min.**	4 hr. 50 min.	4 hr. 10 min.**	4 hr. 27 min.	5 hr. 17 min.*	5 hr. 38 min.	7 hr. 1 min.
Lying (hours and minutes)	4 hr. 30 min.**	4 hr. 24 min.*	3 hr. 41 min.	4 hr. 54 min.**	4 hr. 26 min.	3 hr. 53 min.	3 hr. 17 min.	2 hr. 52 min.
Number of tests	18	12	9	10	5	7	14	6
Average days on test	26.9	28.6	25.3	20.4	30.6	22.0	19.6	26.7
Average number per test	8.7	8.2	6.1	5.5	3.6	3.1	5.5	5.8
Average maximum temp. (degrees F.)	89.3	90.1	91.9	90.9	88.3	88.4	87.2	86.2
Average relative humidity (%)	63.0	63.3	61.8	62.9	62.8	62.7	63.6	64.9

*, **Values significantly (5% and 1% level respectively) different from those of the without-shade treatment.

TABLE 3.—Effects of type of shade on performance and grazing habits of Hereford and Aberdeen-Angus calves

(4-year summary, 1951-1954)

Treatment	Abundant Natural Shade		Scanty Natural Shade		Artificial Shade		Without Shade	
Breed	Hereford	Angus	Hereford	Angus	Hereford	Angus	Hereford	Angus
Number of calves	157	98	55	55	18	22	77	35
Average weight (lb.)	338	332	330	368	330	373	318	329
Average daily gain (lb.)	1.88*	1.79*	1.63*	1.64*	1.86*	1.71*	1.17	1.19
Grazing habits (6 A.M.-7 P.M.)								
Grazing (hours and minutes)	3 hr. 5 min.	3 hr. 3 min.	2 hr. 52 min.	2 hr. 36 min.	2 hr. 58 min.	3 hr. 12 min.	2 hr. 46 min.	2 hr. 31 min.
Standing (hours and minutes)	4 hr. 12 min.	3 hr. 41 min.*	3 hr. 53 min.*	4 hr. 13 min.	3 hr. 53 min.	3 hr. 45 min.*	4 hr. 59 min.	5 hr. 25 min.
Lying (hours and minutes)	5 hr. 43 min.	6 hr. 16 min.	6 hr. 15 min.	6 hr. 11 min.	6 hr. 9 min.	6 hr. 3 min.	5 hr. 15 min.	5 hr. 4 min.
Number of tests	18	12	9	10	5	7	14	6
Average days on test	26.9	28.6	25.3	20.4	30.6	22.0	19.6	26.7
Average number per test	8.7	8.2	6.1	5.5	3.6	3.1	5.5	5.8
Average maximum temp. (degrees F.)	89.3	90.1	91.9	90.9	88.3	88.4	87.2	86.2
Average relative humidity (%)	63.0	63.3	61.8	62.9	62.8	62.7	63.6	64.9

*Values significantly (5% level) different from those of the without-shade treatment.

Although the pastures used were comparable except for the shade differences, the cattle were rotated to different pastures and treatments at the end of each test period in an effort to eliminate any pasture differences.

The influence of the four different treatments on grazing habits was arrived at by observing the cattle hourly during the tests from 6 A.M. until 7 P.M. (13 hours). The time spent grazing, standing, and lying was determined.

Temperature and humidity readings were taken from Standard U.S. Weather Bureau equipment located on the Station. Temperature readings at the different treatments were made 3 feet from the ground.

Results

The results in Tables 2 and 3 are 4-year summaries of the study. The breeds are treated separately in the summaries. Gains recorded for Hereford cows grazing pastures with abundant shade were significantly greater than gains made on pastures without shade. However, gains made by Angus cows while grazing pastures with any kind of shade were significantly greater than those made on pastures without shade. Gains made by the calves of both breeds with any kind of shade were significantly greater than the gains made by calves without shade.

No significant differences were found between breeds in time spent grazing the different treatments during the observation period. Breed differences were observed in time spent standing and lying on the different shade treatments. (Tables 2 and 3.) The time spent standing was greatest on the treatment without shade and lowest with abundant shade. The time spent lying was greatest with abundant shade and tended downward through the treatments without shade.

The influence of treatments on grazing habits suggested increasing discomfort along with the poorer performance of the cattle as the air temperature increased (Table 4). The lack of a significant difference in the grazing time between any of the treatments for cows or calves of either breed was probably due to unobserved night grazing. Miller *et al.* (1951), working with dairy cattle, also failed to find a significant difference in grazing rate between treatments.

Cattle on pastures without shade showed visible need for shade as indicated by panting, excessive walking and standing, reduced rumination, crowding in fence corners, frequent drinking, and lying down in the late afternoon after the temperature had lowered. In contrast the cattle on pastures with shade got up, drank, and started grazing at approximately the same time the cattle without shade started lying down. These visual symptoms of climatic stress were more pronounced during the late spring than later on during the summer. This is in agreement with Kibler and Brody's (1949) findings that rapid changes in environmental temperature tended to accentuate functional response, and that acclimatization of heat production and pulse rate levels to extreme

TABLE 4.—Relation of gain to treatment and temperature (4-year summary, 1951-1954)

Shade Comparison	Av. Max. Temp. Range (Deg. F.)	Temp. Diff. (Deg. F.)	Average Daily Gain Difference (Lbs.)			
			Cows		Calves	
			Hereford	Angus	Hereford	Angus
Without vs Abundant	96.8 90.7	6.1**	1.06*	1.87*	.71*	.60*
Without vs Artificial	96.8 93.0	3.8**	.57	1.39*	.69*	.52*
Without vs Scanty	96.8 93.5	3.3**	.97	1.34*	.46*	.45*
Scanty vs Abundant	93.5 90.7	2.8**	.09	.53	.25	.15
Artificial vs Abundant	93.0 90.7	2.3**	.49	.48	.02	.08
Scanty vs Artificial	93.5 93.0	0.5	.40	.05	.23	.07

*, **Significant at 5% and 1% level respectively.

Cattle on pastures without shade were often observed panting.

changes in environmental temperature required as much as four weeks under some conditions.

The amount of shade available per animal unit on the artificial shade treatment was 32 square feet. Recent studies by Ittner *et al.* (1954) suggest at least 60 square feet of shade is needed per animal (750-1,050 lbs.) and that the shade should be 10-12 feet above ground for best results, because of the radiation effect. The lack of these conditions undoubtedly contributed greatly to the rather poor performance of the cows grazing the pastures with artificial shade. The small area of shade available per animal unit also created a definite sanitation problem.

The calf gains and grazing habits were less affected by the various shade treatments than were those of the cows. When using average daily gains as measurements, it was found that Hereford cows and Angus cows responded approximately 1.5 and 3 times, respectively, as well to the shade treatments as did their calves.

Cartwright (1955) reported summer gains to be the best indicator of heat tolerance of any method studied, and the heritability to be sufficiently high (19 per cent) to use in selection for heat tolerance.

BREED COMPARISON

Comparing breeds of beef cattle is not new. Much of the earlier breed comparison work was concerned with feed lot studies involving carcass quality and yield rather than production problems covering various phases of producing beef cattle. The rapidly expanding position of beef cattle production in the economy of the Southern States in recent years has required studies to determine which breed of beef cattle can be produced to best advantage under southern conditions.

This study was initiated in 1951 and continued through 1955. It covered the various phases of producing Hereford and Angus cattle under improved pasture conditions in West Louisiana. The management system, pasture types, and cattle used were previously discussed on Pages 5 and 6.

Score or Grade

All cattle were scored annually by a grading system which made use of numerical values with 100 as the top grade. The 5-year average grade was 90 for both breeds, thus indicating good breeding animals from the standpoints of conformation and quality. The grade 90 is a practical top for commercial cattle.

Disposition

All cattle 2 years old and up were numerically rated each year as to disposition or ease of handling. All conditions and handling operations under the management system were considered in the rating.

The rating showed that the Hereford cows were significantly easier to handle under the conditions of this study than were the Angus cows.

Weight Comparisons

A weighted monthly 5-year average weight for the respective breeds and age classes is shown in Table 5. The 5-year average weight for Hereford and Angus cows was 982 and 952 pounds respectively. Two-year-old Hereford heifers were 55 pounds heavier on the average than were the two-year-old Angus heifers. There was practically no difference in the weights of the yearling heifers of the two breeds. The average weight range for the Hereford cows was from 885 to 1,062 pounds. The Angus cows ranged in weight from 867 to 1,008 pounds. Hereford and Angus cows and 2-year-old Hereford heifers were heaviest in September of each year. The 2-year-old Angus heifers and Hereford and Angus yearling heifers were heaviest in October of each year.

Performance on Pasture

Gains on pasture from March 1 through September 30 showed a weight advantage consistently in favor of the Hereford cattle. The Hereford cows, 2-year-old heifers, and yearling heifers gained an average of 36, 20, and 62 pounds more respectively than did the same age classes of Angus during the 7-month period. Gerlaugh *et al.* (1951) also reported that Hereford heifers outgained Angus heifers when on pasture.

As expected, gains made by all age classes of both breeds during the earlier, cooler part of the grazing season were significantly greater than the gains made during the remainder of the grazing period.

Wintering Ability

Wintering ability is defined as the success with which the cattle went through the winter, December through February, as measured by loss or gain in weight. The weight losses by the Angus cows were consistently less than by the Hereford cows, but not significantly so. The Hereford cows lost an average of 96 pounds per head during the three months, while the Angus cows lost 87 pounds. The Herefords, being heavier going into the fall, lost weight at a more rapid rate than did the Angus from October through December, but this trend was reversed during January and February. The lowest weights for each breed occurred during February each year.

Calving Per Cent and Per Cent Calf Crop

The average calving per cent during the 5-year period for the Hereford cows was 88 and for the Angus cows, 87. This difference is not significant. The calving per cent ranged from lows of 79 and 75 in 1951 to highs of 100 and 92 in 1955 for the Hereford and Angus cows respectively.

TABLE 5.—Monthly weight comparison of Hereford and Aberdeen-Angus herds

(5-year summary, 1951-1955)

Cattle	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Hereford Bulls	1,620	1,614	1,650	1,709	1,696	1,701	1,706	1,675	1,685	1,705	1,731	1,714	1,682
Angus Bulls	1,313	1,274	1,359	1,358	1,326	1,338	1,350	1,350	1,355	1,353	1,367	1,348	1,338
Hereford Cows	909	885	914	967	1,004	1,041	1,028	1,046	1,062	1,040	981	938	982
Angus Cows	897	867	895	939	989	995	980	992	1,008	997	954	930	952
Hereford 2-Yr.-Old Heifers	742	741	786	858	899	918	954	1,011	1,046	1,005	943	876	879
Angus 2-Yr-Old Heifers	697	701	733	806	837	871	933	964	986	1,000	893	847	824
Hereford Yearling Heifers	466	484	568	619	637	665	662	687	736	746	706	682	624
Angus Yearling Heifers	501	518	590	625	651	665	638	655	708	727	699	702	625

The 5-year average per cent calf crop weaned was 85 for both breeds. The per cent calf crop ranged from lows of 77 and 72 in 1951 to highs of 93 and 91 in 1955 for the Hereford and Angus cows respectively.

Calf death losses throughout the test were losses that could be expected in any breeding herd. The majority of the calves were lost at birth. Semilethal deformities composed most of the remainder.

Birth Weights

The calves were weighed about 4 to 8 hours after birth. The average birth weight of 158 Hereford calves was 64.6 pounds while the average birth weight of 120 Angus calves was 59.1 pounds. The difference is significant and can be attributed in part to the difference in length of gestation period. The Hereford bull calves weighed an average of 65.3 pounds at birth and the Hereford heifer calves averaged 63.8 pounds at birth. The Angus bull calves and heifer calves averaged 61.2 and 57.6 pounds at birth respectively. The Angus birth weights are in close agreement with those reported by Gerlaugh *et al.* (1951), but the Hereford birth weights are approximately 4 pounds lighter than those reported in that study. Hereford birth weights reported by Koch and Clark (1955) are approximately 11 pounds heavier than those reported in this study. Birth weights varied very little from year to year. Shelby *et al.* (1955) have reported that birth weights are slightly affected by differences between years.

Gestation Periods

In this study, 159 gestation periods for Hereford calves averaged 285.37 days. The average of 111 periods for Angus calves was 281.66 days. The difference is statistically significant.

Calves were weighed about 4 to 8 hours after birth.

The difference in gestation periods of Hereford cows carrying bull calves as compared to those carrying heifer calves was 1 day. The bull calves were carried the longest. There was no difference in the gestation periods for Angus bull and heifer calves.

Another point of sufficient importance to mention in connection with gestation periods is the time of calving. The average date for 194 Hereford parturitions was December 19. The average calving date for 126 Angus parturitions was January 8. When considering the length of gestation periods, the Hereford cows were breeding approximately 23 days sooner on the average each year than were the Angus cows. The difference is statistically significant. Bulls were put with both breeds the same date and removed the same date each year.

Weaning Weights and Gains

The average weaning weight of 168 Hereford calves at 240 days of age was 453 pounds. The average weaning weight of 123 Angus calves at 235 days of age was 429 pounds. The 24-pound difference in weight is statistically significant, but the 5-day difference in weaning age is not significant. The Hereford calves made an average daily gain, birth to weaning, of 1.62 pounds. The Angus calves made an average daily gain of 1.57 pounds from birth to weaning. When weaning weights were adjusted to 105 days to eliminate differences in age at weaning, the following adjusted weights were obtained for the 5-year average.

Adjusted and Actual Weaning Weights

	Hereford Calves		*Angus Calves*	
	Steers	*Heifers*	*Steers*	*Heifers*
Adjusted weaning weight	426	398	413	386
Actual weaning weight	454	451	429	430
Actual weaning age	228	254	217	247

The average 205-day weaning weight for all Hereford calves was 413 pounds as compared with 397 pounds for all Angus calves. The difference is significant. Hereford and Angus steer calves were 28 and 27 pounds heavier respectively than the Hereford and Angus heifer calves. Woolfolk and Knapp (1949) reported the difference between steer and heifer calves at weaning to be 28 pounds. Average daily gains based on the 205-day weaning weights amounted to 1.70 pounds for all Hereford calves and 1.65 pounds for all Angus calves.

There are several factors that may have influenced the weaning weights. Some of these factors are relative size of sires and mature size of the breeds, milking abilities of the dams and degree of heat tolerance of the respective breeds. The effect or influence of the sire on birth and weaning weights of the calves could not be measured statistically in this study.

The fact that differences in gaining ability of beef cattle are great and highly heritable (Warwick and Cartwright, 1955) indicates that gaining ability should receive considerable attention in selection of beef breeding cattle.

Production per Cow

In the final analysis, production per cow is the factor of greatest economic importance. The 5-year average annual production per cow for the Herefords was 351 pounds. The 5-year average annual production per cow for the Angus was 337 pounds. The above production figures are based on 205-day weaning weights. The production per cow when based on actual weaning weight was 385 and 365 pounds for the Hereford and Angus cows respectively. Production per cow was found by multiplying either the 205-day weaning weight or the actual weaning weight by the percentage of cows weaning calves, or the per cent calf crop.

Medical Attention and Death Loss

An average of 8 per cent of the Hereford breed, all age classes considered, required medical attention annually, whereas only 6 per cent of the Angus required medical attention.

Medical attention or treatment throughout the study was given for the following causes:

	Hereford	*Angus*
Foot rot	3.07%	2.91%
Retained afterbirth	2.59%	1.45%
Mastitis	1.42%	.58%
Difficult parturition	.71%	.29%
Enteritis	.00%	.58%
Miscellaneous	.47%	.58%

There were no cases of pink eye or cancer eye in either breed during the 5-year period. Screwworm and maggot infestations and bloat cases were not used in figuring the per cent medical attention. However, these production problems were very severe two out of the five years.

The average annual death loss was 1 per cent of all age classes for each breed. These were losses that might be expected in any breeding herd.

MINERAL STUDIES

The low productivity of cattle on native ranges in Louisiana and elsewhere in the South is common knowledge. Small calf crops, light weights, high death losses, and general low productivity mark the cattle running on native range land. Poor breeding, failure to control diseases and parasites, and inadequate nutrition, with emphasis on minerals, are thought to be the principal causes of this low productivity. Campbell *et al.* (1954) found phosphorus of Louisiana range grasses to be consistently below animal diet requirements; calcium appeared to be about adequate in all species sampled, however. Phosphorus deficiency in cattle is characterized by loss of appetite, decreased gains, and depraved appetite which may lead to chewing bones, sticks, old hides, and dead animal material. Long continued phosphorus deficiency results in

The type of protected mineral box that was used during the study.

low percentage calf crop, poor condition, lameness, and stiffness of joints.

The management system for the beef cattle on the Experiment Station necessitated the use of native rangeland, both fertilized and unfertilized, in conjunction with the improved pastures. Thus it was practicable and feasible under these conditions to determine the relative amounts of calcium and phosphorus supplements and salt consumed or needed by the cattle when grazing the fertilized and unfertilized pastures.

Procedure and Results

The cattle grazing the different improved pasture combinations, as well as the fertilized and unfertilized native rangeland, during the 5-year period were used to measure consumption of various mixtures of salt, steamed bone meal, and oyster shell flour. These major mineral elements were fed mainly free choice. Open and weather-protected mineral boxes were used during the study. Measurements were made from the unprotected mineral boxes only between rains, however.

The annual rate of fertilizer application to the improved pastures and to the fertilized native range was approximately 75 pounds of nitrogen, 60 pounds of phosphorus, and 60 pounds of potassium per acre. Lime was applied at the rate of 2 tons per acre every four years.

The average daily consumption rates of salt, bone meal, and oyster shell flour per cow are given in Table 6. The amount of minerals consumed by the calves was charged to the cows. These minerals were fed free choice. Special steamed bone meal which analyzed 15 per cent phosphorus and 30 per cent calcium was used.

TABLE 6.—Average daily mineral consumption per cow when grazing different pasture types

		Improved Pasture	Fertilized Native Pasture	Unfertilized Native Pasture
Average Daily Mineral Consumption				
Salt	ounces	1.31	1.34	2.58
Bone Meal	ounces	.17	.20	.36
Oyster Shell Flour	ounces	.15	.00	.00
Minerals Furnished by Bone Meal				
Phosphorus	grams	.71	.88	1.53
Calcium	grams	1.42	1.76	3.06
Mineral Furnished by Oyster Shell Flour				
Calcium	grams	1.58	.00	.00
Daily Mineral Requirements				
Phosphorus	grams	15.00	15.00	15.00
Calcium	grams	16.00	16.00	16.00
Minerals Furnished by Pastures				
Phosphorus	grams	14.29	14.12	13.47
Calcium	grams	13.00	14.24	12.94

Phosphorus and calcium requirements from "Recommended Nntrient Allowances for Beef Cattle," National Research Council, Sept. 1945.

The data indicate that the cows received approximately 95, 94, and 90 per cent of their phosphorus requirements from the forage of the improved, fertilized native, and unfertilized native pastures respectively. The data also indicate that the cows received approximately 80, 89, and 80 per cent of their calcium requirements from the respective pasture types. However, this only assumes that the cows were meeting their calcium and phosphorus requirements. There was no definite criterion as to whether the cows were actually getting the amount of mineral they should have had. The phosphorus consumption of the cows on the unfertilized native range pastures was lower than might have been expected. This was probably due to the frequent rotation of cattle to different pasture types, thus allowing them to meet their phosphorus requirements through the highly fertilized forage on the improved pastures. Also the implication (see Table 6) that the forage of the different pasture types was lower in calcium than in phosphorus is due to the fact that the cattle were forced to consume twice as much calcium as phosphorus when eating the bone meal. Cattle on the range pastures did not eat any oyster shell flour when it was fed free choice. Calcium has been found to be adequate or nearly so (Campbell *et al.* 1954) in Louisiana range grasses. This also illustrates that mineral substances such as oyster shell and ground limestone should not be used as mineral supplements for cattle in this area of Louisiana, because they contain only calcium and are entirely lacking in phosphorus, for which there is much greater need. Bone meal contains about twice as much calcium as phosphorus and usually supplies more calcium than is needed. It is not wise to use mineral mixtures containing considerably more calcium than phosphorus. Therefore it is not advisable to mix calcium supplements with high phosphorus supplements such as bone meal, bone black, and dicalcium phosphate, for these products themselves furnish ample calcium.

The consumption of bone meal showed a marked seasonal trend and the seasonal variation was rather consistent each year. Consumption rate of salt and bone meal was highest during late summer and fall just prior to calving. The bone meal consumption was not high during the winter months, presumably because of the phosphorus being received in the cottonseed cake. Two pounds of cottonseed cake daily provides approximately enough phosphorus to meet the requirement.

Mixtures of salt and bone meal ranging from 9 parts salt to 1 part bone meal, and 9 parts bone meal to 1 part salt were used on all pasture types. The consumption rate of these mixtures was highly variable; however, low consumption rate of the low salt-high bone meal mixtures was consistent on all pasture types, except during late fall just prior to calving. The strong indications that cattle will consume appreciable amounts of bone meal only when they need phosphorus in addition to what they are receiving in the forage and other supplements, and the fact that consumption rate of the various salt-bone meal mixtures was highly variable, leads one to recommend free choice mineral feeding over mineral mixtures.

Numerous mineral mixtures are being used that contain very small amounts of phosphorus and large amounts of unneeded minerals; therefore stockmen should check the percentage and cost of available phosphorus. Practical stockmen know that pasture forage is the principal and cheapest source of minerals. Therefore it is both good economy and good nutrition to limit any intake of supplemental minerals to those which are actually deficient in the forage being grazed or fed.

SUMMARY

Hereford and Angus cows, yearling heifers and calves were found to graze an average of 5-5½ hours, 4½-5 hours, and 3½-4 hours respectively per day during an observation period from 6 A.M. to 6 P.M. Hereford cows made significantly greater gains during this early grazing period than did the Angus cows, but there were no significant differences between the gains of the yearling heifers and calves of the two respective breeds.

Of the types of shade studied, abundant natural shade proved the best for both breeds. This was the only type of shade under which Hereford cows made significantly greater gains than when grazing pastures without shade. The Angus cows made significantly greater gains when grazing pastures with any type of shade than when grazing pastures without shade. Gains made by the calves of both breeds when grazing the different shade types were significantly greater than their gains when on pastures without shade. Calves of both breeds performed similarly under the different shade types.

No significant differences were found between breeds in time spent grazing the different shade types during the 13-hour (6 A.M.-7 P.M.) observation period. However, breed differences were observed as to the time spent standing and lying on the different shade types. The influence of the different shade types on the grazing habits suggested increasing discomfort along with the lower daily gains of the cattle as the average air temperature of the treatments increased.

Cattle of both breeds on pastures without shade visibly indicated a need for shade by panting, excessive walking and standing, reduced rumination, crowding in fence corners, frequent drinking, and lying down in the late afternoon after the temperature had lowered.

The poor performance of cattle on pastures with artificial shade was attributed to the small amount of shade available per cow and the low height of the shade shelters.

Gains and grazing habits in calves were affected less by the different shade treatments than they were in the cows. It was found that the Hereford and Angus cows responded approximately 1.5 and 3 times, respectively, as well to the shade treatments as did their calves.

A detailed study covering the various phases of producing Hereford and Angus cattle under improved pasture conditions in West Louisiana was conducted over a 5-year period.

Hereford cows were found to be significantly easier to handle under the conditions of this study than were the Angus cows.

The average weight of the Hereford and Angus bulls during the study was 1,682 and 1,338 pounds respectively. The Hereford cows averaged 30 pounds heavier than the Angus cows during the study, and Hereford 2-year-old heifers held an average weight advantage of 65 pounds during the study. Yearling heifers of each breed weighed approximately the same.

Hereford cows, 2-year-old heifers, and yearling heifers gained consistently more when on pasture, March through September 30, than did the same age classes of Angus. Gains made by all age classes of both breeds during the earlier, cooler part of the grazing season were significantly greater than the gains made during the remainder of the grazing period.

Angus cows lost less weight during the winter months, December through February, than the Hereford cows, but the difference in weight loss was not significant.

The average calving per cent for the Hereford cows was 88 and for the Angus cows, 87. The average per cent calf crop weaned was 85 for both breeds.

The average birth weight for the Hereford calves was 64.6 pounds while the average birth weight for the Angus calves was 59.1 pounds. The difference is significant.

The gestation periods averaged 285.37 days for the Hereford calves and 281.66 days for the Angus calves. The difference is significant.

Hereford cows bred approximately 23 days sooner each year than did Angus cows. The difference is significant.

Hereford calves were significantly heavier at weaning than were the Angus calves.

The 5-year average annual production per cow when based on adjusted weaning weights was 351 pounds for the Hereford cows and 337 pounds for the Angus cows.

An average of 8 per cent of the Hereford herd, all age classes, required medical attention annually, whereas only 6 per cent of the Angus herd required medical attention.

The average annual death loss was 1 per cent of all age classes for each breed.

Cattle grazing under a management system that involved the combined use of improved pastures, fertilized native pastures, and unfertilized native pastures were found to receive an approximate average of 93 per cent of their assumed phosphorus requirements from the pasture forage.

Free choice mineral feeding was found to be advantageous over mixed mineral feeding. Calcium supplements, such as oyster shell flour and ground limestone, were not found to be necessary.

ACKNOWLEDGMENTS

The writer wishes to express his gratitude to Dr. George L. Robertson, Head of the Department of Animal Industry, Louisiana State University, and to Mr. John K. Riggs, Professor of Animal Husbandry, Texas A&M College, for their assistance and guidance in preparing this bulletin.

LITERATURE CITED

Annual Report. 1953. Sixty-Sixth Annual Report. Miss. Agr. Expt. Sta., Pp. 58-59.

Annual Report. 1954. Okla. Agr. Expt. Sta. Misc. Pub. No. MP-34, Pg. 71.

Campbell, Robert S., E. H. Epps, C. C. Moreland, F. L. Farr, and Frances Bonner. 1954. Nutritive values of native plants on forest range in Central Louisiana. La. Agr. Expt. Sta. Bul. 488.

Cartwright, T. C. 1955. Responses of beef cattle to high ambient temperatures. Journal of Animal Science, 14: 350.

Gerlaugh, Paul, L. E. Kunkle and D. C. Rife. Crossbreeding beef cattle. Ohio Agr. Expt. Sta. Res. Bul. 703. 1951.

Ittner, N. R., and C. F. Kelly. 1951. Cattle shades. Journal of Animal Science, 10: 184.

Ittner, N. R., T. E. Bond, and C. F. Kelly. 1954. Increasing summer gains of livestock. Journal of Animal Science, 13: 867.

Kelly, C. F., and N. R. Ittner. 1948. Artificial shades for livestock in hot climates. Agr. Eng., 29: 239.

Kibler, H. H., and Samuel Brody. 1949. Environmental physiology. Mo. Agr. Expt. Sta. Res. Bul. 450.

Koch, Robert M., and R. T. Clark. 1955. Influence of sex, season of birth and age of dam on economic traits in range beef cattle. Journal of Animal Science, 14: 386.

Miller, G. D., J. B. Frye, Jr., B. J. Burch, Jr., P. J. Henderson, and L. L. Rusoff. 1951. The effect of sprinkling on the respiration rate, body temperature, grazing performance, and milk production of dairy cattle. Journal of Animal Science, 10: 961.

Shelby, C. E., R. T. Clark, and R. R. Woodward. 1955. The heritability of some economic characteristics of beef cattle. Journal of Animal Science, 14: 372.

Warwick, Bruce L., and T. C. Cartwright. 1955. Heritability of rate of gain in young growing beef cattle. Journal of Animal Science, 14: 363.

Woolfolk, E. J., and Bradford Knapp, Jr. 1949. Weight and gain of range calves as affected by rate of stocking. Mont. Agr. Expt. Sta. Bul. 463.

Worstell, D. M., and Samuel Brody. 1953. Environmental physiology and shelter engineering. Mo. Agr. Expt. Sta. Res. Bul. 515.

La
630.7
L93b
#503

Stardel

A New Cotton Variety

By F. W. SELF

Field of Stardel in Caddo Parish, 1955

Bulletin No. 503

April 1956

Agricultural Experiment Station
J. N. Efferson, Director

Louisiana State University
and
Agricultural and Mechanical College

Stardel: A New Cotton Variety

By Ferd W. Self[1]

Basis for Release of the Stardel Variety

The annual gross value of cotton and cotton seed normally exceeds 100 million dollars in Louisiana. The estimated value of lint in 1955 was approximately 95 million dollars. According to best available estimates, the 1954 Louisiana cotton acreage was planted proportionately to the following varieties: 94 per cent to Deltapine 15, 2 per cent to Fox, 2 per cent to Delfos 9169, 2 per cent to all other varieties. A moderate increase of 7 per cent in the production of lint per acre for the state of Louisiana would mean a considerable boost in the income of cotton producers.

The new variety Stardel has yielded 7 per cent more lint per acre than the most extensively grown variety. Stardel not only produces more lint per acre, but it combines high fiber strength with high yield, thereby affording growers an opportunity to grow better quality and more cotton.

History and Pedigree

In 1948, at the Louisiana Agricultural Experiment Station at Baton Rouge, Louisiana, a cross was made between Stoneville 2B-462, a strain with high fiber strength, and Deltapine 14. Stoneville cotton originated from a selection out of Lone Star in 1916. Deltapine 14 is a high producing strain with high lint percentage, medium boll, and average staple length. Progenies of this cross were selfed and superior plants in F_2 and later generations were selected and propagated by plant-to-the-row selections. In 1953, 3 strains out of 14 from this cross were selected for rapid multiplication and testing. One strain, Louisiana DS 524-9, demonstrated from the beginning of the tests that it possessed the desired characteristics of high production, high lint percentage, high fiber strength, average boll size, medium staple length, and good picking qualities. The Louisiana DS 524-9 was tested on six Louisiana Agricultural Experimental Farms for the three-year period 1953-55.

Description

Stardel may be described as follows: The plants are medium in height, vigorous, spreading in growth habit and medium in their earliness. The picking qualities are good as the bolls open well and are fluffy. It has good storm proofness. The lint per cent ranges from 37 to 40, which is high. The lint length ranges from 33/32 to 35/32 inches, with an over-all average of 34.3/32 inches. The foliage is medium to light, a good characteristic in areas of moderate to high rainfall. The boll size ranges from 75 to 90 per pound. The fiber is very strong, ranging from 92,000 to 97,000 pounds per square inch, with an average of about 95,000. Fiber strength is an important factor in yarn strength of the medium staple length classes of cotton. The fiber fineness is of average micronaire units (4.5 to 4.8). Stardel fibers are about 10 per cent stronger than those of any of the other commercial varieties in production in Louisiana. The variety has given good spinning performance in spinning trials and offers Louisiana cotton growers an opportunity to produce better quality cotton along with high lint yields.

---

[1] Associate Agronomist, Louisiana State University Agricultural Experiment Station.

Performance

The performance of Stardel in terms of yield, staple length, lint percentage, boll size, and yarn strength is given in the following tables.

Table 1.—Comparative Yields of Stardel and other Leading Varieties in Louisiana, 1953-55

Lint Yields for Indicated Locations

1953

Variety	St. Joseph	Bossier City	Baton Rouge	Lecompte	Calhoun	Homer
Stardel (La. DS 524-9)	1216	1256 1250	....	959	....	....
Deltapine 15	1026	891 1032	....	998	....	....
Fox	1108	780	....	827	....	....

1954

Variety	St. Joseph	Bossier City	Baton Rouge	Lecompte	Calhoun	Homer
Stardel	1256 1187	243 372	799	....	312	208
Deltapine 15	1200 1077	275 240	732	....	322	173
Fox	1111 1076	259 293	741	....	332	201
Delfos 9169	1146 1208	260 273	748	....	355	146

1955

Variety	St. Joseph	Bossier City	Baton Rouge	Lecompte	Calhoun	Homer
Stardel	1006 1200 1421	835 884	776 1064	318	1039	....
Deltapine 15	1106 1263 1365	815 863	844 969	279	963	....
Fox	950 1210 1297	953 842	655 855	294	1060	....
Delfos 9169	981 1053 1123	773 715	715 747	289	860	....

State Lint per Acre Averages Corrected to Seasonal Effects

Variety	1953	1954	1955	3-Year Ave.
Stardel	1170	625	949	880
Deltapine 15	987	574	941	822
Fox	905	573	902	787
Delfos 9169	....	591	806	762

Yield Records

Stardel has been widely tested in Louisiana during the past three years. It has yielded 7 per cent more lint per acre than Deltapine 15, 12 per cent more than Fox, and approximately 15 per cent more than Delfos 9169. Lint yield records are given in Table 1. The experiments were conducted at St. Joseph, Bossier City, Baton Rouge, Calhoun, Lecompte and Homer. Big differences in yield in any particular year or station are evident from the data in Table 1.

Staple Length

Staple length determinations were made by the U.S.D.A. Cotton Classing office at Alexandria, Louisiana. These data show a wide range in staple length for all varieties due to environment and location in the different years. Stardel and Delfos 9169 had an average staple length slightly greater than the other two varieties (Table 2).

Table 2.—Comparative Staple Length of Stardel and other Leading Varieties in Louisiana, 1953-55

Staple Length in 1/32" for Indicated Locations

1953

Variety	St. Joseph	Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel (La. DS 524-9)	35	35	34	....	34	....	....
Deltapine 15	35	35	33	....	35	....	....
Fox	35	35	..	....	35	....	....

1954

Variety	St. Joseph		Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel	35	35	33	32	34	....	34	32
Deltapine 15	35	35	33	32	33	....	34	32
Fox	35	35	34	32	34	....	34	32
Delfos 9169	36	36	34	32	34	....	34	32

1955

Variety	St. Joseph			Bossier City		Baton Rouge		Lecompte	Calhoun	Homer
Stardel	35	35	35	34	35	35	35	34	35	....
Deltapine 15	34	35	35	34	35	35	35	33	34	....
Fox	34	33	35	34	34	34	35	34	33	....
Delfos 9169	35	35	36	34	34	35	35	34	35	....

State Staple Length Averages

Variety	1953	1954	1955
Stardel	34.5	33.6	34.8
Deltapine 15	34.5	33.4	34.4
Fox	35.0	33.7	34.0
Delfos 9169	. . .	34.0	34.8

Lint Percentage

There are many important criteria for judging a cotton variety, but lint percentage is one of the important characteristics that influence farmers in their choice of a variety. Stardel is a variety of high lint percentage (Table 3).

Table 3.—Comparative Lint Per Cent of Stardel and other Leading Varieties of Louisiana, 1953-55

Lint Per Cent for Indicated Locations

1953

Variety	St. Joseph	Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel (La. DS 524-9)	39.5	39.5	39.5	....	39.5	....	....
Deltapine 15	39.0	38.9	39.3	....	39.9	....	....
Fox	36.3	36.2	...	....	36.6	....	....

1954

Variety	St. Joseph		Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel	39.8	39.5	39.9	39.4	40.0	....	37.9	39.1
Deltapine 15	39.1	39.7	39.2	38.6	40.0	....	38.1	39.0
Fox	36.5	36.1	36.0	33.6	37.5	....	35.4	34.6
Delfos 9169	35.6	35.8	34.5	34.2	37.9	....	34.4	33.1

1955

Variety	St. Joseph			Bossier City		Baton Rouge		Lecompte	Calhoun	Homer
Stardel	39.1	40.5	39.3	36.8	37.0	39.0	38.3	38.1	39.2	....
Deltapine 15	39.1	39.5	38.9	36.1	36.4	39.1	38.3	37.3	38.5	....
Fox	35.5	37.8	38.4	34.3	34.2	35.6	37.7	35.5	36.0	....
Delfos 9169	34.5	35.5	35.5	33.4	33.4	36.1	36.2	33.4	34.7	....

State Lint Per Cent Averages

Variety	1953	1954	1955
Stardel	39.5	39.4	38.6
Deltapine 15	39.3	39.1	38.1
Fox	36.4	35.7	36.1
Delfos 9169	...	35.1	34.7

Boll Size

The boll size may vary for any particular variety or year. However, varieties on the average keep their relative rank in boll size at any location. The growing conditions influence the average boll size of all varieties in about the same proportion. Data in Table 4 give the ranges of boll size for the varieties at the different experiment stations. Stardel and Fox boll size was slightly smaller than boll size of the other two varieties.

Table 4.—Comparative Boll Size of Stardel and other Leading Varieties in Louisiana, 1953-55

Boll Size for Indicated Locations

1953

Variety	St. Joseph	Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel (La. DS 524-9)	80	77	88	....	76	....	....
Deltapine 15	77	73	89	....	68	....	....
Fox	80	78	..	....	76	....	....

1954

Variety	St. Joseph		Bossier City		Baton Rouge	Lecompte	Calhoun	Homer
Stardel	73	84	68	87	93	....	93	91
Deltapine 15	69	78	80	87	91	....	97	89
Fox	75	83	72	89	87	....	106	93
Delfos 9169	64	68	78	76	77	....	86	89

1955

Variety	St. Joseph			Bossier City		Baton Rouge		Lecompte	Calhoun	Homer
Stardel	71	75	69	86	83	81	75	83	80	....
Deltapine 15	67	70	65	77	76	73	72	91	72	....
Fox	70	68	67	80	81	80	78	77	77	....
Delfos 9169	55	61	56	68	66	58	61	64	61	....

State Boll Size Average

Variety	1953	1954	1955
Stardel	80.3	84.1	78.1
Deltapine 15	76.8	84.4	73.7
Fox	78.0	86.4	75.3
Delfos 9169	...	76.9	61.1

Yarn Strength

Yarn strength is an important characteristic which mill buyers use in choosing areas to purchase raw cotton. With the present day emphasis upon better quality cotton, all of our cotton varieties must possess good fiber properties. Cotton buyers are continually seeking varieties that give excellent mill performances.

According to fiber technologists, the three most important fiber properties which contribute to high yarn strength generally have proved to be fiber strength, fiber fineness, and fiber length. Yarn strength is an important factor in the milling performance of quality cotton in average staple length and average fineness classes.

Stardel produces fiber of average fineness and high strength. These characteristics will enable growers of this variety to produce better quality cotton.

Spinning Test of Stardel and Deltapine 15 at Gilliam, La., in 1955*

	Length		Yarn Length	
	U.H.M.	Mean	22's	50's
Stardel	1.13	.91	133.7	46.7
Deltapine 15	1.08	.85	113.1	38.0

*The spinning test was conducted by U. S. D. A. Production and Marketing Service, College Station, Texas.

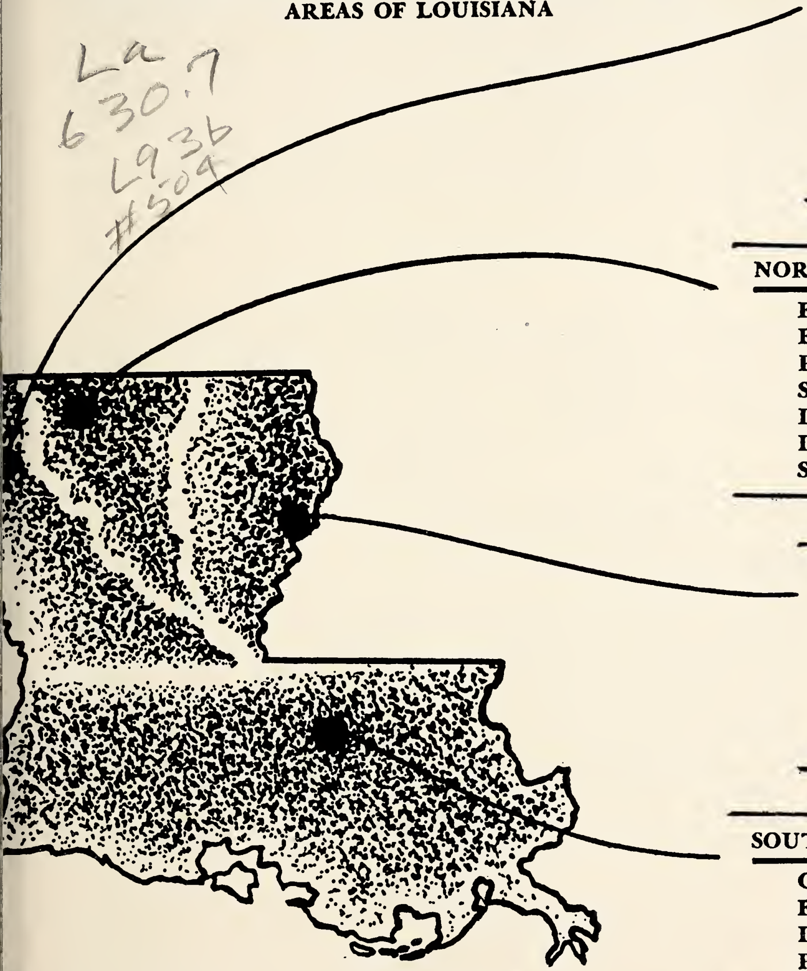
The fiber of Stardel is very strong. This probably is an important factor in giving Stardel higher 22's and 50's yarn strength than Deltapine 15. The fiber strength of Deltapine 15 is average. The spinning and other fiber tests indicate that Stardel is approximately 10 per cent stronger than Deltapine 15.

ulletin No. 504 June, 1956

Cotton Variety Tests in Louisiana, 1951-55

VARIETIES RECOMMENDED FOR THE FOUR PRODUCING AREAS OF LOUISIANA

La
630.7
L93b
#504



NORTHWESTERN

- Fox
- Delfos 9169
- Empire
- Deltapine 15
- Plains
- Stoneville 5A-3202
- Coker 100 WR

NORTHERN

- Fox
- Empire
- Plains
- Stoneville 5A-3202
- Deltapine 15
- Delfos 9169
- Stoneville 2B

NORTHEASTERN

- Stoneville 5A-3202
- Deltapine 15
- Delfos 9169
- Plains
- Fox
- Coker 100 WR

SOUTHERN

- Coker 100 WR
- Fox
- Deltapine 15
- Plains
- Stoneville 5A-3202

W. Self, J. A. Hendrix, J. Y. Oakes,
D. M. Johns and R. S. Woodward

Agricultural Experiment Station
J. N. Efferson, Director
Louisiana State University
and
Agricultural and Mechanical College

SUMMARY

Averages of yield and other characteristics for cotton varieties and new strains tested at five locations in Louisiana during the five-year period 1951-55 are presented.

The over-all lint per acre averages of nine commercial varieties of cotton that have been tested for five years at Baton Rouge and St. Joseph and four years at Bossier City, Calhoun and Homer, Louisiana (Table 19), rank them in the following order: Fox, Plains, Deltapine 15, Delfos 9169, Stoneville 5A-3202, Empire, Coker 100 WR, Stoneville 2B and Bobshaw 1-A. The leading varieties at Baton Rouge were Coker 100 WR, Fox, Deltapine 15, Plains and Stoneville 5A-3202; at St. Joseph the leading varieties were Stoneville 5A-3202, Deltapine 15, Delfos 9169, DES 7343 and Plains; and at Calhoun the leading varieties were Fox, Plains, Stoneville 2B, Stoneville 5A-3202 and Empire. Differences in averages for lint per acre at Bossier City were significant only in 1955.

RECOMMENDED COTTON VARIETIES FOR LOUISIANA

On the basis of results obtained, the following commercial varieties are recommended for Louisiana.

Northwestern	*Northern*	*Northeastern*	*Southern*
Fox	Fox	Stoneville 5A-3202	Coker 100 WR
Delfos 9169	Empire	Deltapine 15	Fox
Empire	Plains	Delfos 9169	Deltapine 15
Deltapine 15	Stoneville 5A-3202	Plains	Plains
Plains	Deltapine 15	Fox	Stoneville 5A-3202
Stoneville 5A-3202	Delfos 9169	Coker 100 WR	
Coker 100 WR	Stoneville 2B		

A new variety, Stardel, tested as Louisiana DS 524-9, has been developed by the Louisiana Agricultural Experiment Station. It has performed better than Deltapine 15, Fox or Delfos 9169 in both yield and strength. Foundation seed of Stardel was released for 1956. A detailed description of Stardel and information on its performance are given in Louisiana Experiment Station Bulletin 503, "Stardel, a New Cotton Variety."

Cotton Variety Tests in Louisiana, 1951-55

F. W. SELF,[1] J. A. HENDRIX,[2] J. Y. OAKES,[3] D. M. JOHNS,[4]
AND R. S. WOODWARD[5]

INTRODUCTION

New and leading cotton varieties have been tested in Louisiana for a number of years. At certain periods or intervals summaries or reports are prepared in order that one may compare the behavior of current varieties. Since cotton breeders are continually making improvements in varieties and strains, tests are needed every year so that the changes or trends may be evaluated. Because of the nature of cotton plants and the variable environmental conditions, the summaries include only varieties that have been tested for five years. This length of time affords an opportunity to interpret current variety behavior. Some data for varieties that have been tested less than five years are presented in Tables 3, 6, 10, 15 and 18. The yield of lint for years in which the varieties were grown and the estimated comparable corrected averages of yield of lint are also presented. The new strains test averages cover a period of three years at St. Joseph and Bossier City, Louisiana. The detailed variety and new strains test results have been published in the preliminary mimeograph reports of the Crops and Soils Department for 1951-1955.

The estimated* average acre yield of lint in Louisiana for the past five years was 415 pounds of lint per acre. The general trend in Louisiana has been toward more lint per acre on fewer acres.

PROCEDURE FOR COTTON VARIETY TESTING IN LOUISIANA

The yield of seed cotton was based on the mean weight from six replications of single-row plots approximately 100 feet in length at each location, with the exception of the commercial variety and mechanization tests at Bossier City, which were four rows wide and approximately 445 feet in length. Lint percentage was determined by ginning two 100-boll samples from each variety on a small roller gin.

The boll size determinations were obtained from 100-boll samples. The staple length measurements were obtained from a 10-pound sample of each variety after it had been ginned on a small saw gin. The grade determinations for the variety and mechanization tests at Bossier City were obtained from a regular gin sample. The fiber length and grade classifications were made by Luther Rone, Harvey B. Martin and their associates of the Production and Marketing Administration Cotton Classing Office in Alexandria, Louisiana.

---

[1] Associate Agronomist, Louisiana Agricultural Experiment Station.

[2] Superintendent, Northeast Louisiana Experiment Station.

[3] Superintendent, Red River Valley Experiment Station.

[4] Superintendent, North Louisiana Hill Farm Experiment Station.

[5] Superintendent, North Louisiana Experiment Station.

**The Cotton Situation*, United States Department of Agriculture, Agricultural Marketing Service.

The planting, cultivating and harvesting of the cotton variety tests located at the State Experiment Stations were supervised by J. A. Hendrix, J. Y. Oakes, R. S. Woodward, D. M. Johns and F. W. Self. The auhors are indebted to L. L. McCormick, G. E. Wilcox, D. R. Melville, C. N. Bollich, J. E. Jones and C. B. Haddon for their assistance in conducting these tests.

The seed used in these cotton variety tests were obtained from the following sources:

Ambassador 569—Stoneville Pedigreed Seed Company, Stoneville, Miss.
Auburn 56—Alabama Agricultural Experiment Station, Auburn, Ala.
Bobshaw 1-A—Bobshaw Seed Company, Indianola, Miss.
Cobal—U. S. Cotton Field Station, Knoxville, Tenn.
Coker 100 WR 5—Coker's Pedigreed Seed Company, Hartsville, S. C.
Coker 100 Staple—Coker's Pedigreed Seed Company, Hartsville, S. C.
Coker 4 in 1—Coker's Pedigreed Seed Company, Hartsville, S. C.
Deltapine 33 (Hale)—G. A. Hale, Burdette, Ark.
Deltapine 15—Delta and Pine Land Company, Scott, Miss.
Delfos 9196—Stoneville Pedigreed Seed Company, Stoneville, Miss.
Delfos 9169-1325, 1348—Northeast Louisiana Experiment Station, St. Joseph, La.
Delfos 444 x Deltapine 1-4—Northeast Louisiana Experiment Station, St. Joseph, La.
Delta Pride—Bobshaw Seed Company, Indianola, Miss.
Deltapine Staple—Delta and Pine Land Company, Scott, Miss.
DES 7343, 8274—Delta Branch Experiment Station, Stoneville, Miss.
Empire—Empire Pedigreed Seed Company, P. O. Box 7, Haralson, Ga.
Early Fluff—Georgia Coastal Plain Experiment Station, Tifton, Ga.
E. H. 806 Long Staple—W. H. Jenkins, Pee Dee Experiment Station, Florence, S. C.
Fox—Delta and Pine Land Company, Scott, Miss.
Louisiana 33—Louisiana Agricultural Experiment Station, Baton Rouge, La.
Louisiana 33 x 14—Louisiana Agricultural Experiment Station, Baton Rouge, La.
Louisiana DS strains—Louisiana Agricultural Experiment Station, Baton Rouge, La.
Miller A—Mississippi State College, State College, Miss.
Northern Star—Wacona Seed Farm, Waco, Tex.
Pandora—Georgia Coastal Plain Experiment Station, Tifton, Ga.
Paula 20, 40—Deering Farm Incorporated, Deering, Mo.
Plains—Alabama Agricultural Experiment Station, Auburn, Ala.
Stardel—Louisiana Agricultural Experiment Station, Baton Rouge, La.
Stoneville 2B, 7—Stoneville Pedigreed Seed Company, Stoneville, Miss.
Stoneville 5A—Stoneville Pedigreed Seed Company, Stoneville, Miss.
Stoneville 62—Oklahoma Agricultural Experiment Station, Stillwater, Okla.
Smith 78—McQueen Smith Farms, Prattville, Ala.
Stoneville Z106—Delta Branch Experiment Station, Stoneville, Miss.
Stonewilt—W. W. Wannamaker, St. Mathews, S. C.
Wacona—Wacona Seed Farms, Waco, Tex.
Wilds—Coker's Pedigreed Seed, Hartsville, S. C.
Tidewater x 45-210-515—Northeast Louisiana Experiment Station, St. Joseph, La.

Each test received the fertilizer treatment recommended for the area and normal cultivation for good crop growth. Each year the cotton boll weevil was present in sufficient numbers to require a regular dusting or spraying program. In 1955, the boll weevil control program at Bossier City and St. Joseph, Louisiana was hampered by excessive rainfall during July and August (Tables 4 and 8). It was also noted that excessive rainfall during June, July and August frequently has a depressing effect upon the yield per acre of varieties in the rich river-bottom soils of Louisiana.

RESULTS FROM VARIETY TESTS

The mean yields of the varieties at each station have been summarized in Tables 2, 5, 7, 9, 11, 14 and 17.

Tables 3, 6, 10, 15 and 18 present a summary of mean yields for the varieties, the years grown, and comparable relative mean lint yields of varieties that were not grown each year. The comparable yields of those varieties were obtained as illustrated at the bottom of Tables 3, 6, 10, 15 and 18.* The correction factors were obtained from the mean acre yields of the varieties that were grown in the period of years observed. This correction was determined in the equation: $\overline{X} - XY = C$, where $\overline{X}$ is the grand average of the varieties that have been grown every year in the period of years summary, XY is the mean of the Yth year, and C is the correction factor. The correction factor for each year was then added, algebraically, to the yield values for all varieties within that year. This gives a set of estimated comparable yields, as shown in Tables 3, 6, 10, 15 and 18.

SOUTH LOUISIANA TESTS

F. W. Self

Cotton Variety Averages of Tests, 1951-55, Baton Rouge, La.

The tests at Baton Rouge were conducted at the Perkins Road Farm of the Louisiana Agricultural Experiment Station located three miles east of Baton Rouge, La. The tests were conducted on Olivier silt loam in 1951 through 1954 and on Foley silt loam in 1955. The tests received 600 pounds of 6-8-8 fertilizer and 100 pounds of sodium nitrate as a side-dressing each year. Nematodes were controlled in 1954 and 1955 by the application of ethylene dibromide W 85 three weeks before planting the experimental plots.

East Baton Rouge Parish receives annually, as an average, 59.29 inches of rainfall. Forty-five per cent of this total amount falls, as an average, during the months of April through August. For the five-month period, the Baton Rouge rainfall was 46 per cent below average in 1951;

---

*Patterson, R. E., "A Method of Adjusting for Calculating Comparable Yields in Variety Tests," *Agronomy Journal*, 42:509-511, 1950.

TABLE 1.—Rainfall data, April through August, at Baton Rouge, La., 1951-55

	Months					Total 5-month departure
Year	April	May	June	July	August	
1951	2.23	1.07	2.32	7.44	1.42	−12.34
1952	5.84	7.42	1.58	6.29	2.42	− 3.27
1953	6.63	10.70	2.71	5.45	6.04	+ 5.35
1954	1.94	5.81	2.93	6.75	1.55	− 7.20
1955	8.35	4.20	3.53	6.19	3.63	− .01
Monthly Average	4.39	5.31	4.77	6.84	5.51	

12.2 per cent below average in 1952; 19.9 per cent above average in 1953; 26.8 per cent below average in 1954; and .01 per cent below average in 1955.

The tests were planted on April 25, 1951; May 5, 1952; May 11, 1953; April 22, 1954; and May 3, 1955. Two plants per hill were spaced approximately 16 inches apart in the row.

TABLE 2.—Five-year averages for cotton varieties tested on the Louisiana Agricultural Experiment Station, Perkins Road Farm, Baton Rouge, La., 1951-55

Variety	Yield in pounds of lint per acre					Five-year average			
	1951	1952	1953	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No bolls per pound
Coker 100 WR	499	715	625	888	569	659	36.8	34	71
Fox	499	683	698	741	655	655	37.1	34	83
Deltapine 15	489	612	555	732	844	646	39.8	34	79
Plains	485	724	691	749	553	641	37.0	34	74
Stoneville 5A-3202	482	701	650	734	590	631	38.1	34	78
DES 7343	481	551	515	704	871	625	39.6	34	79
Delfos 9169	482	615	418	748	715	596	36.5	35	69
Empire	548	549	585	796	407	577	37.2	34	62
Stoneville 2B	480	510	551	764	522	565	36.3	34	69
Bobshaw 1-A	450	642	559	637	517	561	36.8	33	82
Mean lint per acre	490	630	585	749	624	616			
Difference for significance	*	95	87	*	100	45			

The six varieties Coker 100 WR, Fox, Deltapine 15, Plains, Stoneville 5A-3202 and DES 7343 were the highest yielding, as an average, of the ten in the five-year comparison. These varieties differed in certain other characteristics. Coker 100 WR and Plains were resistant to fusarium wilt, whereas Deltapine 15, Fox and DES 7343 produced, on an average, smaller bolls than the other four varieties.

In the group of varieties that were grown for a portion of the five years, La. DS 5349405, Coker 100 WR 1952 BRS, La. DS 518-12, La. DS 542-9, La. DS 5240-5 and La. DS 533749 yielded very well. The estimated corrected mean yield comparison was prepared to facilitate comparison of certain varieties and new strains that were not grown each year.

TABLE 3.—Mean yield by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than five years on the Louisiana Experiment Station, Perkins Road Farm, Baton Rouge, La., 1951-55

Variety	Yield in pounds of lint per acre							Average		
	1951	1952	1953	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Correction factors	+126	−15	+31	−133	−9					
Louisiana DS 5349405	....	....	....	....	807	807	798	38.1	34	77
Coker 100 WR 1952 BRS	....	736	....	....	....	736	721	37.3	35	69
Louisiana DS 524-9	....	....	....	799	776	788	717	39.6	34	87
Deltapine Staple	....	....	....	....	726	726	717	36.3	34	70
Louisiana DS 518-3	....	....	....	....	718	718	709	36.3	34	77
Louisiana 33 x 14	....	....	....	837	707	772	701	40.2	34	78
Louisiana DS 523-9	....	....	....	736	794	765	694	37.2	34	77
Louisiana DS 5240-5	....	....	....	770	746	758	687	39.8	33	84
Louisiana DS 533749	....	....	....	....	692	692	683	39.5	33	68
Louisiana DS 518-12	....	....	....	737	742	740	668	40.4	32	83
Stonewilt	493	723	....	....	....	608	664	36.4	34	74
Louisiana 33	511	689	664	....	....	600	656	38.2	34	76
Early Fluff	530	....	....	....	....	530	656	38.6	34	78
Smith 78	523	....	....	....	....	523	649	37.7	35	76
Hybrid 56-4-M	491	....	....	....	....	491	617	37.4	34	75
Delfos 8274	....	523	....	....	....	523	616	37.0	35	79
Delfos 9169-1348	500	....	....	725	....	613	609	37.8	34	79
Paula 40	474	....	....	....	....	474	600	39.8	34	72
Pandora	467	....	....	....	....	467	593	38.2	34	70
Stoneville 2B-5235	453	....	....	....	....	453	579	37.4	34	70
Louisiana DS 5219-2	....	....	....	....	574	574	565	38.7	33	72
Louisiana DS 523-7	....	....	....	682	559	621	550	38.1	34	88
Coker 100 Staple	461	494	545	....	....	500	547	36.2	36	77
Delta Pride	418	....	....	....	....	418	544	35.0	36	73
Paula 20	410	....	....	....	....	410	536	36.4	35	69
Miller A	426	501	....	....	....	464	519	37.6	33	72
Dixie King	....	....	....	....	500	500	491	36.1	34	59
Auburn 56	....	....	....	....	493	493	484	35.0	34	68

*Estimated adjusted mean yield. The average yield of Louisiana DS 524-9, for example, was obtained as follows: (799 - 133) + (776 - 9) /2 = 717.

NORTHEAST LOUISIANA TESTS

J. A. Hendrix, *Superintendent*

Cotton Variety and New Strain Averages for Tests, 1951-55, St. Joseph, La.

These tests were conducted on the Northeast Louisiana Experiment Station located approximately three miles north of St. Joseph, La. The soil in the test area was Commerce silt loam of dark brownish gray Mississippi River bottom phase. The cotton variety tests were rotated so as to follow soybeans. In 1951, 290 pounds of ammonium sulfate was applied deep in the furrow and bedded on two weeks before planting time. In 1952, 168 pounds of ammonium nitrate was applied April 9 deep in the furrow and bedded on; in 1953, 200 pounds of ammonium nitrate was applied April 14 and bedded on; in 1954, 75 pounds of nitrogen was bedded on April 15; in 1955, 75 pounds of nitrogen was applied to the test area and bedded on March 23.

St. Joseph receives annually, as an average, 21.79 inches of rainfall, or 42.2 per cent of its annual rainfall, during the five months April through August. In 1951, the rainfall was approximately 10.86 inches below average; in 1952, 10.68 inches below average; in 1953, 7.91 inches above average; in 1954, 0.15 inches below average; and in 1955, 2.81 inches above average.

TABLE 4.—Rainfall data, April through August, at St. Joseph, La., 1951-55

Year	Months					Total 5-month departure
	April	May	June	July	August	
1951	2.81	0.71	3.80	2.70	0.91	−10.86
1952	2.86	5.55	0.09	1.72	0.89	−10.68
1953	8.89	15.29	0.71	1.86	2.95	+ 7.90
1954	4.02	10.59	2.00	4.56	1.14	− 0.15
1955	7.30	5.80	0.49	7.08	4.60	+ 2.81
Monthly Average	5.47	4.30	3.85	4.86	3.31	

The rainfall data at this station indicate that average or above average rainfall fell during April and May but slightly below average during July and August except in 1955, in which year the monthly averages were above average.

The tests were planted on April 26, 1951; on April 29, 1952; on May 9, 1953; on April 27, 1954; and on April 27, 1955.

Stoneville 5A-3202, Deltapine 15, Delfos 9169, DES 7343, Plains and Fox were the leading varieties, as an average, of the ten varieties in the five-year comparison.

In the group of varieties that were grown less than five years, it may be observed from the estimated mean adjusted yields that Dortch 4106,

TABLE 5.—Five-year averages for cotton varieties tested on the Northeast Louisiana Experiment Station, St. Joseph, 1951-55

Varieties	Yield in pounds of lint per acre					5-year average			
	1951	1952	1953	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Stoneville 5A-3202	1060	922	1190	1214	1073	1091	37.4	35	73
Deltapine 15	1168	905	1016	1200	1106	1079	39.3	35	72
Delfos 9169	1076	961	1204	1146	981	1073	35.0	36	62
DES 7343	1086	990	1162	1178	924	1068	39.1	36	73
Plains	1057	911	1082	1146	1075	1054	36.2	35	65
Fox	1106	806	1065	1111	950	1007	36.0	35	78
Bobshaw 1-A	935	835	1140	1109	909	985	36.7	35	74
Coker 100 WR	1048	825	1035	1081	857	969	35.0	35	69
Stoneville 2B	1002	844	999	1121	827	958	35.0	35	63
Empire	903	818	1134	1012	832	939	35.3	35	59
Mean lint per acre	1004	882	1103	1132	953	1022			
Difference for Significance	80	94	74	*	89	48			

*Difference not significant.

Coker 100-52-27, Stoneville 7, Coker 100 51-24-LH, Deltapine 33 (Hale), Louisiana DS 524-9, Deltapine 8389-D and Ambassador No. 569 performed well on the average at this station (Table 6).

TABLE 6.—Mean yields by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than five years on the Northeast Louisiana Experiment Station, St. Joseph, La., 1951-55

Variety	Yield in pounds of lint per acre							Average		
	1951	1952	1953	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Correction factors	− 21	+141	− 79	−109	+ 70					
Dortch 4106	....	....	....	....	1104	1104	1174	39.1	35	66
Coker 100 52-27	....	....	....	....	1103	1103	1173	36.4	35	61
Stoneville 7	....	....	....	....	1074	1074	1144	38.7	34	67
Coker 100 51-24-LH	....	....	....	1257	1022	1140	1120	37.1	35	65
Deltapine 33 (Hale)	....	978	....	....	....	978	1119	40.9	34	76
Louisiana DS 524-9	....	....	....	1256	1006	1131	1112	39.4	35	73
Deltapine 8389-D	1074	....	....	....	1097	1086	1110	37.9	34	70
Ambassador 569	968	....	....	....	....	968	1109	34.7	33	59
Delfos 9169-3316	1116	....	....	....	....	1116	1095	32.9	38	63
Louisiana 33 x 14	....	....	1229	1145	....	1187	1093	39.8	34	72
Delfos 8274	1146	910	....	....	....	1082	1088	37.7	36	77
Dixie King	....	....	....	....	1015	1015	1085	36.1	35	50
Stoneville 2B-7398	....	921	....	....	....	921	1062	36.6	35	67
Coker 100 51-18	....	....	....	1169	....	1169	1060	37.1	36	72
Stoneville Z 106	....	915	....	....	....	915	1056	37.1	34	67
Coker 100 50-39	....	....	1134	....	....	1134	1055	35.5	36	73
Paula 40	1060	....	....	....	....	1060	1039	36.6	35	63
Coker 100 50-81	....	....	1117	....	....	1117	1038	36.1	35	63
Deltapine Staple	....	....	....	....	963	963	1033	36.5	36	64
Coker 100 51-30	....	....	....	1138	....	1138	1029	36.4	35	69
Stoneville 2B-5235	1046	....	....	....	....	1046	1025	33.2	36	67
Louisiana 33	1029	929	1066	....	....	1008	1022	36.1	34	72
Coker 100 51-55	....	....	....	1119	....	1119	1010	36.0	35	64
Northern Star	....	....	....	1108	.	1108	999	36.2	34	56
Auburn 56	1030	861	....	1191	827	977	998	34.7	36	70

(Continued)

TABLE 6 (Continued).—Mean yields by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than five years on the Northeast Louisiana Experiment Station, St. Joseph, La., 1951-55

Variety	Yield in pounds of lint per acre							Average		
	1951	1952	1953	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Stonewilt	1011	....	....	....	....	1011	990	33.2	37	71
Wacona	....	....	....	1073	....	1073	964	36.6	34	61
Coker 100-50-3987	....	....	....	1070	....	1070	961	35.2	35	68
Coker 100 Staple	1030	739	1069	....	....	946	960	33.9	36	72
Coker 4 in 1-143	977	....	....	....	....	977	956	32.9	37	70
Coker 100 49-196 RH	....	....	....	1046	903	975	955	34.4	35	69
Delfos 9169-1348	....	....	1052	1075	853	993	954	35.0	36	60
Stoneville 5A-8809	....	811	....	....	....	811	952	37.1	35	72
Coker 100 WR 1953 BRS	....	808	....	....	....	808	949	35.5	34	71
Delfos 9169-1325	....	....	1013	....	....	1013	934	35.3	35	69
Paula 20	952	....	....	....	....	952	931	32.1	36	61
Smith 78	946	....	....	....	....	946	925	32.3	37	69
Miller A	1046	681	....	....	....	864	924	35.6	33	67
Delfos 44 x Deltapine 1-4	939	....	....	....	....	939	918	32.8	37	77
Deltapine 8387 C-54-62-72	....	....	997	....	....	997	918	36.4	34	84
Cobal	923	....	....	....	....	923	902	32.5	37	58
Pandora	923	....	....	....	....	923	902	32.6	36	63
Delta Pride	855	809	....	....	....	832	892	32.4	37	72
Coker 100 52-36	....	....	....	....	780	780	850	35.3	35	64
Wilds	832	646	....	....	....	739	799	30.9	38	73
Tidewater x 45-210-515	817	....	....	....	....	817	796	31.5	37	75
E. H. 806 Long Staple	781	632	....	....	....	706	766	31.9	42	73

*Estimated Adjusted Mean Yields. The average acre yield of Louisiana 33 x 14 for example, was obtained as follows: (1229-79) + (1145-109) /2 = 1093.

TABLE 7.—Three-year averages for new strains tested on the Northeast Louisiana Experiment Station, St. Joseph, La., 1953-55

Variety	Yield in pounds of lint per acre			3-year average			
	1953	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Louisiana DS 524-9	1216	1187	1200	1201	39.8	35	80
Louisiana DS 518-12	1295	1146	1153	1198	41.5	34	77
Louisiana DS 517-39	1203	1111	1276	1196	39.6	34	72
Louisiana DS 518-8	1212	1198	1142	1184	39.0	34	69
Louisiana DS 5219-2	1236	1130	1035	1134	38.1	34	72
Louisiana DS 5216-10	1199	1079	1118	1132	40.2	34	70
Fox	1108	1076	1210	1131	36.8	35	77
Deltapine 15	1026	1077	1263	1122	39.4	35	75
Louisiana DS 523-9	1076	1031	1207	1100	37.6	34	72
Louisiana DS 523-7	1100	975	919	999	37.5	34	83
Mean lint per acre	1166	1101	1152	1140			
Difference for Significance	103	91	170	75			

The new-strains tests were conducted in the same manner as the commercial varieties test.

Louisiana DS 524-9, Louisiana DS 518-12, Louisiana DS 517-39, Louisiana DS 518-8, Louisiana DS 5219-2, Louisiana DS 5216-10 and Fox were the leading new strains in this three-year experiment.

NORTHWEST LOUISIANA TESTS

J. Y. Oakes, *Superintendent*

Cotton Variety Averages of Tests, 1951-55, Curtis, La.

The tests at Curtis were conducted on the Red River Valley Experiment Station approximately eight miles south of Curtis, La. The soil type is Yahola very fine sandy loam-Red River bottom soil. The tests received 40 pounds of nitrogen per acre in 1951; 65 pounds of nitrogen per acre in 1952; 65 pounds of nitrogen per acre in 1954; and 60 pounds of nitrogen per acre in 1955.

The Bossier City area receives annually, as an average, 44 inches of rainfall. The area received approximately 19.43 inches during the five months April through August. The area received approximately 49 per cent below average in 1951; .02 per cent below average in 1952; 31 per cent above average in 1953; 12 per cent below average in 1954; and 66 per cent above average in 1955 during these five months.

The average rainfall at this station was below average during the five-month period for three of the four years. The extremely hot dry weather in July and August in 1954 reduced the over-all average yield of all varieties and new strains at this station.

The tests were planted on May 1, 1951; on May 1, 1952; on May 18, 1954; and on April 26 in 1955.

TABLE 8.—Rainfall data, April through August, Bossier City, La., 1951-55

Year	Month					Total 5-month departure
	April	May	June	July	August	
1951	1.82	1.10	2.81	3.30	0.47	− 9.11
1952	5.34	6.71	0.74	4.26	1.11	− 0.45
1953	9.82	8.35	1.30	3.03	1.22	+ 5.87
1954	3.93	7.94	1.88	1.01	0.92	− 2.17
1955	4.78	9.64	2.67	6.17	6.83	+12.24
Monthly average	4.63	4 22	3.50	3.56	2.70	

TABLE 9.—Four-year averages of cotton varieties tested on the Red River Valley Experiment Station, Curtis, La., 1951-55

Variety	Yields in pounds of lint per acre				4-year average			
	1951	1952	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Fox	754	1145	259	953	778	35.8	34	83
Delfos 9169	849	1195	260	773	769	34.4	35	68
Empire	645	1205	214	830	724	35.8	34	63
Deltapine 15	687	990	275	815	692	38.4	34	75
Plains	630	1184	239	690	686	35.8	34	70
Coker 100 WR	631	1223	236	570	665	34.0	35	71
Stoneville 2B	668	1076	166	698	652	34.6	34	70
Mean lint per acre	695	1145	236	761	709			
Difference for significance	*	*	*	75	*			

*Difference not significant.

TABLE 10.—Mean yield by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than four years on the Red River Valley Experiment Station, 1951-55

Variety	Yield in pounds of lint per acre						Average		
	1951	1952	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Correction factors	+ 15	−436	+473	− 52					
DES 8274	746	1245	....	....	996	785	37.7	34	72
DES 7343	....	1195	264	834	764	759	37.4	34	78
Louisiana DS 524-9	....	....	243	835	539	750	38.4	34	88
Stoneville 62-84	....	1184	....	....	1184	748	37.1	34	71
Louisiana DS 518-3	....	....	274	....	274	747	37.0	32	84
Early Fluff	698	....	....	....	698	713	34.5	34	75
Deltapine 15-8129	....	1147	....	....	1147	711	38.5	34	75
Delfos 9169-1348	....	....	236	....	236	709	34.9	34	75
Deltapine 8389-A	719	1113	....	....	916	706	39.4	34	76
Dixie King	....	....	....	745	746	694	35.1	34	61
Delfos 9169-3316	677	....	....	....	677	692	34.7	36	70
Louisiana 33 x 14	....	....	241	716	478	689	38.4	34	88
Louisiana DS 523-7	....	....	215	....	215	688	36.1	34	83
Bobshaw 1-A	556	1157	....	798	840	683	35.1	34	78
Louisiana DS 523-9	....	....	209	....	209	682	36.7	33	77
Delfos 8306	666	....	....	....	666	681	39.6	35	81
Coker 100 Staple	614	1163	....	....	888	678	34.3	35	73

(*Continued*)

TABLE 10 (Continued).—Mean yield by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than four years on the Red River Valley Experiment Station, 1951-55

Variety	Yield in pounds of lint per acre						Average		
	1951	1952	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Stoneville 5A-3202	592	1111	....	801	835	677	36.7	34	76
Deltapine 15-759	....	1111	....	....	1111	675	38.2	34	66
Paula 40	617	....	....	....	617	632	36.1	34	65
Miller A	581	1099	....	....	840	630	36.6	34	66
Louisiana 33	548	1045	241	....	611	629	36.4	34	74
Auburn 56	697	....	....	688	692	624	34.1	34	74
Smith 78	600	....	....	....	600	615	34.0	35	75
Paula 20	600	....	....	....	600	615	33.6	35	67
Stoneville Z 106	...	1040	....	....	1040	604	34.7	34	63
Stoneville 2B-5235	585	....	....	....	585	600	34.2	35	67
Stonewilt	572	....	....	....	572	587	34.0	34	73
Deltapine 14-312	570	....	....	....	570	585	38.7	34	86
Cobal	537	....	....	....	537	552	34.0	34	67
Pandora	504	....	....	....	504	519	33.7	34	75
Wilds	493	....	....	....	493	508	29.8	40	72
E.H. 806 Long Staple	482	....	....	....	482	497	31.4	39	77
Tidewater X45-210-515	472	....	....	....	472	487	30.6	39	89
Deltapride	471	....	....	....	471	486	31.3	36	71

*Estimated adjusted mean yields. The average acre yield of DES 8274, for example, was obtained as follows: (746 + 15) + (1245 − 436) /2 = 785.

TABLE 11.—Three-year averages of new strains tested on the Red River Valley Experiment Station, Curtis, La., 1953-55

Variety	Yield in pounds of lint per acre			3-year average			
	1953	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Louisiana DS 524-9	1256	372	884	837	38.6	34	82
Louisiana DS 518-9	1256	347	863	822	38.0	34	77
Louisiana DS 5219-2	1176	255	786	739	36.2	33	74
Louisiana DS 518-12	1000	301	913	738	39.1	33	78
Deltapine 15	891	240	863	665	38.0	34	79
Fox	780	293	842	638	34.7	34	83
Louisiana DS 5240-5	784	215	870	623	37.2	34	80
Mean lint per acre	1020	289	860	723			
Difference required for Significance	173	*	*	91			

*Difference not significant.

The new-strains tests were conducted in the same manner as the commercial varieties test.

Louisiana DS 524-9 and Louisiana DS 518-9 were the leading new strains in this three-year study and yielded significantly more lint per acre than Deltapine 15 or Fox, the commercial checks.

TABLE 12.—Fours years of cotton varieties and new strains harvested mechanically, Curtis, La., 1952-55

Variety	Yield in pounds of lint per acre				Mechanical harvesting efficiency (per cent)				Grade			
	1952	1953	1954	1955	1952	1953	1954	1955	1952	1953	1954	1955
Deltapine 15	1091	1032	275	815	87.2	89	80	85	SLM	M	SLM	Mid. Lt. Sp.
Fox	1194	....	259	953	88.8	..	72	88	M	..	SLM	Mid. Sp.
Delfos 9169	....	....	260	773	....	..	78	83	..	..	SLM	Mid. Lt. Sp.
Louisiana DS 524-9	....	1250	243	835	....	88	68	85	..	M	SLM	LM
Plains	....	....	239	690	....	..	61	88	..	..	SLM	Mid. Lt. Sp.
Coker 100 WR	....	....	236	590	....	..	67	79	..	..	SLM	Mid. Lt. Sp.
Empire	....	....	214	830	....	..	60	87	..	..	SLM	LM
Stoneville 2B	....	....	166	698	....	..	63	78	..	..	SLM	Mid. Lt. Sp.
DES 7343	....	....	264	834	....	..	72	79	..	..	SLM	Mid. Lt. Sp.
Louisiana 33 x 14	....	....	241	716	....	..	79	73	..	..	SLM	Mid. Lt. Sp.
Delfos 9169-1348	....	....	236	....	....	..	73	..	..	..	SLM	
Louisiana DS 518-3	....	....	274	....	....	..	73	..	..	..	SLM	
Louisiana DS 523-7	....	....	215	....	....	..	71	..	..	..	LM	
Louisiana DS 523-9	....	910	209	....	....	79	65	..	..	M	SLM	
Louisiana DS 518-11	1146	1218	....	....	84.6	83	..	..	M	M		
Louisiana DS 5248-14	....	1181	....	....	....	74	..	..	..	M		
Louisiana DS 5243-1	....	1164	....	....	....	84	..	..	..	M	....	....
Louisiana DS 5243-5	....	1155	....	....	....	87	..	..	..	M	....	....
Louisiana DS 5232-9	....	1149	....	....	....	83	..	..	..	M	....	....
Louisiana DS 518-12	1192	1125	....	....	87.4	80	..	..	SLM	M	....	....
Louisiana DS 5241-3	....	1122	....	....	....	88	..	..	..	M	....	....
Louisiana DS 5252-12	....	1073	....	....	....	91	..	..	..	M	....	....
Louisiana DS 518-16	1292	1034	....	....	88.0	76	..	..	SLM	M	....	....
Louisiana DS 5216-3	....	997	....	....	....	80	..	..	..	M	....	....
Louisiana DS 2550-1	....	827	....	....	....	60	..	..	..	M	....	....
Stoneville 5A-3202	....	....	....	801	....	..	..	83	..	..	....	Mid. Lt. Sp.
Bobshaw 1-A	....	....	....	798	....	..	..	88	..	..	....	Mid. Lt. Sp.
Dixie King	....	....	....	746	....	..	..	80	..	..	....	Mid. Lt. Sp.
Auburn 56	....	......	....	688	....	..	..	79	..	..	....	Mid. Lt. Sp.
Deltapine 8389-D-521	1345	....	....	....	88.0	..	..	..	LM+	..	....	....
Deltapine 15-8129	1292	....	....	....	85.5	..	..	..	SLM	..	....	....
Louisiana DS 517-39	1207	....	....	....	89.0	..	..	..	M	..	....	....

(*Continued*)

TABLE 12 (Continued).—Four years of cotton varieties and new strains experiments harvested mechanically, Curtis, La., 1952-55

Variety	Yield in pounds of lint per acre				Mechanical harvesting efficiency (per cent)				Grade			
	1952	1953	1954	1955	1952	1953	1954	1955	1952	1953	1954	1955
Deltapine 15-757	1074	....	....	....	86.6	..	..	..	M	..	...	....
Deltapine 14-51	1030	...	.	.	83.0	..	..	..	SLM	..	....	....
Mean lint per acre	1186	1088	238	769	...							
Difference required for significance	97	146	*	74								

* Difference not significant.

The number of varieties and strains that could be evaluated in a mechanical harvesting experiment has been limited owing to the plot size required. Most of the varieties responded in a similar manner in their efficiency for harvesting and grade for any particular year. The results indicate that, on the average, 10 to 15 per cent of the cotton will be left in the field; however, when severe drouth occurs, the amount left by the machine may be as high as 25 per cent. A large portion of the cotton left in the field, however, is faulty or damaged bolls.

NORTH LOUISIANA EXPERIMENT STATION TESTS

R. S. Woodward, *Superintendent*

Cotton Variety Averages of Tests, 1951-55, Calhoun, La.

These tests were conducted on the North Louisiana Experiment Station at Calhoun, La. They were located on well-drained Orangeburg sandy texture type soil. The soil is highly productive in years of ample rainfall. The tests received 600 pounds of 6-8-8 fertilizer in 1951; 600 pounds of 6-8-8 fertilizer in 1952; 600 pounds of 8-8-8 fertilizer in 1954; and 500 pounds of 8-8-8 fertilizer in 1955.

The Calhoun area receives, as an average, 21.08 inches of rainfall during the months of April through August. In 1951 the station received approximately 36 per cent below average; in 1952, 38 per cent below average; in 1954, 23 per cent below average; and in 1955, 23 per cent above average. The highest average acre yield was made in the year in which the rainfall was 23 per cent above average.

TABLE 13.—Rainfall data, April through August, Calhoun, La., 1951-55

Year	Months					Total 5-month departure
	April	May	June	July	August	
1951	3.03	1.18	3.82	3.77	1.66	−7.62
1952	5.32	3.39	0.60	2.22	1.48	−8.07
1954	3.37	9.76	0.12	1.90	0.23	−4.82
1955	5.46	7.55	3.49	6.12	2.42	+4.84
Monthly average	4.90	4.75	3.52	4.43	3.48	—

The tests were planted on May 1, 1951; on May 5, 1952; on April 20, 1954; and on April 19, 1955. Two plants were spaced approximately 16 inches apart in the row. Empire, Fox, Delfos 9169, Deltapine 15, Plains and Stoneville 5A-3202 were the leading varieties, as an average, of the nine varieties in the four-year comparison.

TABLE 14.—Four-year averages for cotton varieties tested on the North Louisiana Experiment Station, Calhoun, La., 1951-55

Variety	Yield in pounds of lint per acre				4-year average			
	1951	1952	1954	1955	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Empire	549	615	392	1047	651	36.7	34	62
Fox	579	540	332	1060	628	36.3	34	89
Delfos 9169	682	611	355	864	627	35.4	35	73
Deltapine 15	603	561	322	963	612	38.5	34	81
Plains	523	591	328	990	608	36.5	34	73
Stoneville 5A-3202	554	565	380	916	604	37.1	34	80
Bobshaw 1-A	515	633	323	899	592	35.9	34	84
Stoneville 2B	589	544	366	787	572	35.2	34	72
Coker 100 WR	471	513	278	938	550	34.9	34	77
Mean lint per acre	563	575	342	940	605			
Difference for significance	78	*	47	118	40			

*Difference not significant.

TABLE 15.–Mean yields by years and estimated adjusted* average acre yield of lint of cotton varieties grown less than four years on North Louisiana Experiment Station, Calhoun, La., 1951-55

Variety	Yield in pounds of lint per acre						Average		
	1951	1952	1954	1955	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	No. bolls per pound
Correction factors	+ 42	+ 31	+263	–336					
Louisiana DS 518-12	....	....	....	1144	1144	808	40.9	33	72
Early Fluff	623	....	....	....	623	665	34.8	35	76
Paula 40	621	....	....	....	621	663	38.4	36	71
Dixie King	....	....	....	983	983	647	37.4	34	52
Louisiana DS 518-9	....	....	....	981	981	645	40.4	34	67
Louisiana 33 x 14	....	....	286	1068	677	640	38.0	34	77
Louisiana DS 524-9	....	....	312	1039	676	639	38.6	34	87
Smith 78	592	....	....	....	592	634	33.4	36	73
Delfos 9169-3316	585	....	....	....	585	627	36.0	37	71
Deltapine 8389	576	....	....	....	576	618	38.1	35	80
Delfos 9169-1348	....	....	346	934	640	604	34.6	34	75
Paula 20	561	....	....	....	561	603	32.4	36	72
DES 7343	....	584	....	925	754	602	39.0	33	78
Auburn 56	564	564	....	....	564	600	35.0	34	74
Stonewilt	536	579	....	....	558	594	35.0	34	76
Louisiana DS 5240-5	....	....	317	936	626	590	38.3	34	85
Stoneville 2B-5235	543	....	....	....	543	585	32.9	36	70
Louisiana DS 5219-2	....	....	359	881	620	584	37.1	33	83
Miller A	538	555	....	....	546	583	35.9	33	74
Louisiana DS 523-9	....	....	322	913	618	581	36.0	34	74
Louisiana 33	487	601	286	....	458	570	36.6	34	80
DES 8274	....	534	....	....	534	565	38.5	34	83
Coker 100 Staple	551	503	....	....	527	564	34.4	36	79
Pandora	492	....	....	....	492	534	34.7	36	71
Louisiana DS 523-7	....	....	252	784	518	482	35.8	34	88
Deltapine Staple	....	....	....	800	800	464	36.3	35	65

* Estimated adjusted mean yields. The average acre yield of Louisiana 33 x 14, for example, was obtained as follows: (286 + 263) + (1068 – 336) /2 = 640.

NORTH LOUISIANA HILL FARM EXPERIMENT STATION TESTS

D. M. Johns, *Superintendent*

Cotton Variety Averages of Tests, 1951-54, Homer, La.

The tests at Homer were conducted on the North Louisiana Hill Farm Experiment Station approximately three miles south of Homer, La. The tests were located on well-drained Ruston type soil.

The tests received 600 pounds of 6-8-8 fertilizer in 1951; 800 pounds of 8-8-8 fertilizer in 1952; 600 pounds of 8-8-8 fertilizer in 1953; and 600 pounds of 8-8-8 fertilizer in 1954.

The Homer area receives, as an average, 21.16 inches of rainfall from April through August. The Minden, La., weather station (the closest long-time weather records) reported rainfall approximately 36 per cent below average in 1951; 27 per cent below average in 1952; 44 per cent below average in 1953; and 24 per cent below average in 1954.

TABLE 16.—Rainfall data, April through August, Minden, La., 1951-54

Year	Months					Total 5-month departure
	April	May	June	July	August	
1951	2.38	1.90	5.14	2.80	1.55	−7.78
1952	6.07	5.16	1.56	1.69	1.21	−5.86
1953	12.17	10.11	0.29	0.27	3.03	−9.42
1954	4.27	7.07	1.25	0.14	1.99	−5.25
Monthly average	5.01	4.86	3.28	4.60	3.80	

The tests were planted on April 23, 1951; on May 31, 1952; on April 20, 1953; and April 20, 1954. Two plants per hill were spaced 16 inches apart in the row.

Fox, Plains, Stoneville 2B, Stoneville 5A-3202, Empire and Coker 100 were the leading varieties, as an average, of the nine varieties in the four-year comparison.

TABLE 17.—Four-year averages for cotton varieties tested on the North Louisiana Hill Farm Experiment Station, Homer, La., 1951-54

Variety	Yield in pounds of lint per acre				4-year average			
	1951	1952	1953	1954	Lint per acre	Lint per cent	Staple length in 1/32"	No. bolls per pound
Fox	334	297	501	201	333	35.8	33	96
Plains	329	266	454	203	313	35.7	33	91
Stoneville 2B	352	245	415	173	296	34.4	33	87
Stoneville 5A-3202	300	254	450	177	295	36.8	34	94
Empire	314	241	424	141	280	35.7	33	80
Coker 100 WR	332	254	364	166	270	34.1	33	91
Bobshaw 1-A	349	259	356	146	277	34.6	33	98
Deltapine 15	331	218	373	173	273	37.9	33	99
Delfos 9169	303	191	374	146	253	34.6	34	87
Mean lint per acre	327	247	412	170	289			
Difference for significance	76	*	*	38	35			

*Difference not significant.

TABLE 18.—Mean yields by years and estimated adjusted* average acre yield of lint cotton varieties grown less than four years on the North Louisiana Hill Farm Experiment Station, Homer, La., 1951-54

Variety	Yield in pounds of lint per acre					Average			
	1951	1952	1953	1954	Ave.	Corrected average	Lint per cent	Staple length in 1/32"	** No. bolls per pound
Correction factors	– 38	+ 42	–123	+119					
Louisiana 33 x 14	....	....	592	141	367	365	39.4	33	89
Louisiana DS 524-9	...	....	..	208	208	327	39.1	33	91
Louisiana 33	341	258	496	....	365	325	36.5	33	95
Delfos 9169-3316	355	....	. ..	....	355	317	34.2	34	..
Stonewilt	348	250	....	....	299	301	33.9	33	90
Pandora	339	....	....	....	339	301	36.7	33	..
Miller A	316	243	434	.. .	331	291	34.9	31	90
Louisiana DS 5219-2	....	....	....	163	163	282	35.6	32	89
Auburn 56	293	267	....	....	280	282	33.3	33	99
Smith 78	317	....	....	....	317	279	36.0	34	..
Louisiana DS 523-7	....	....	....	151	151	274	34.9	33	97
Paula 20	310	....	....	....	310	272	33.6	34	..
Louisiana DS 523-9	....	....	....	148	148	267	36.2	32	87
Louisiana DS 5240-5	...	....	....	146	146	265	39.2	32	101
Coker 100 Staple	279	243	313	....	302	262	33.8	35	95
Delfos 9169-1348	....	....	....	142	142	261	35.8	32	87
DES 7343	....	177	423	....	300	260	36.6	33	100
DES 7284	....	216	....	....	216	258	33.5	34	111
Stoneville 2B-5235	270	....	....	....	270	232	33.8	34	..
Paula 40	243	....	....	....	243	205	36.9	34	..

*Estimated adjusted mean yields. The average yield of Louisiana 33 x 14, for example, was obtained as follows: (592 – 123) + (141 + 119) /2 = 447.

**No boll size data were collected in 1951.

STATE AVERAGES FOR NINE LEADING VARIETIES

The data for the nine varieties Fox, Delfos 9169, Plains, Deltapine 15, Stoneville 5A-3202, Empire, Coker 100 WR, Stoneville 2B and Bobshaw 1-A have been analyzed statistically at the five stations in yield of lint per acre. It was found that the varieties responded in a different manner at the five stations and these differences were significant. The analysis also indicates that these station yield averages were highly influenced by environmental conditions and the varieties may change their rank in yield in any future summary.

TABLE 19.—State averages of lint per acre for nine commercial varieties at Baton Rouge, St. Joseph, Curtis, Calhoun and Homer, La.

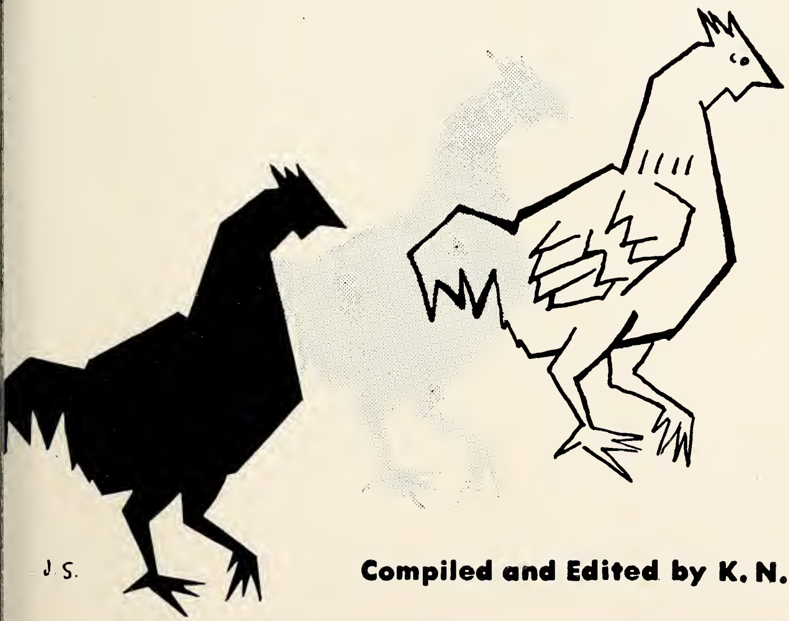
Vaviety	Average yield in pounds of lint per acre				
	5-year average		4-year average		
	Baton Rouge	St. Joseph	Curtis	Calhoun	Homer
Fox	655	1007	778	628	333
Delfos 9169	596	1073	769	627	253
Plains	641	1054	686	608	313
Deltapine 15	646	1079	692	612	273
Stoneville 5A-3202	631	1091	655	604	295
Empire	577	939	724	651	280
Coker 100 WR	659	969	665	550	279
Stoneville 2B	565	958	652	572	296
Bobshaw 1-A	561	985	604	592	277

Data show that Fox, Plains and Deltapine 15 ranked relatively higher than the other six varieties in yield of lint per acre. Deltapine 15 and Stoneville 5A-3202 produced, on the average, higher lint per cent; Empire and Delfos 9169 had larger bolls; and Delfos 9169 produced longer fiber. Plains, Empire and Coker 100 WR were resistant to fusarium wilt.

ulletin No. 505 June 1956

rocessing Losses and Meat Yields of Chickens of Broiler and Light Roaster Weights

La
630.7
L93b
#505



Compiled and Edited by K. N. May

AGRICULTURAL EXPERIMENT STATION
J. N. EFFERSON, DIRECTOR

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE

TABLE OF CONTENTS

Page

I. ABSTRACT 3

II. ACKNOWLEDGMENTS 4

III. INTRODUCTION 5

IV. REVIEW OF LITERATURE
- A. Processing Losses 5
- B. Edible Meat Yield As Related To Specific Body Measurements 7
- C. Edible Meat Yield Obtained By Separating Raw Meat From Bone 8
- D. Edible Meat Yield Obtained By Separating Cooked Meat From Bone 9

V. EXPERIMENTAL PROCEDURE
- A. 1949-50 Experiments 10
- B. 1951 Experiment 11
- C. 1952 Experiments 11
- D. 1953-54 Experiments 12
- E. Statistical Treatments 12

VI. RESULTS AND DISCUSSION
- A. 1949-50 Experiments 12
- B. 1951 Experiment 14
- C. 1952 Experiments 15
- D. 1953-54 Experiments 16

VII .SUMMARY AND CONCLUSIONS 18

VIII. BIBLIOGRAPHY 19

IX. APPENDIX I 21

X. APPENDIX II 35

ABSTRACT

The studies of processing losses and meat yields reported extended over a period of six years (1949-54) and involved 1,110 chickens of broiler and light roaster weights. Various commercial broiler strains and crosses and some egg strain stocks were compared in the studies. Detailed records were kept of processing losses, bone plus cartilage losses and meat yield. Carcass measurements including keel length, breast width and body depth were obtained from 350 birds of broiler weight. In addition to raw meat yield observations, some samples were cooked in steam retorts and cooked yields are shown. Results indicate that, at a given weight, females gave greater percentage eviscerated yields and greater percentage edible meat yields than did males. The superior yield of the females was about 1.5 per cent of live weight in the case of eviscerated yield and about 0.5 to 3.2 per cent of eviscerated weight in the case of edible yields. These differences were statistically significant. At a given weight, Cornish varieties gave superior percentages of eviscerated yields and meat yields, Cornish crossbreds gave intermediate yields and non-Cornish stocks gave the lowest yields. These differences were statistically significant. Differences in edible meat yields were shown to be due to breast yields, giblet yield and bone loss or lighter skeletal weight and not due to "other meat" yields, which did not differ significantly between stocks. Of the measures used, breast width proved to be the best single measure for predicting yields. Differences in raw and cooked bone yield (roughly 15 per cent of eviscerated weight) indicated that edible yields should not be calculated as the difference between cooked bone weight and raw ready-to-cook weight.

The average eviscerated yield as a percentage of unstarved live weight for all stocks tested ranged from 64.3 to 68.5 per cent, while the average meat yield of all stocks tested ranged from 46.2 to 57.8 per cent of eviscerated weight.

ACKNOWLEDGMENTS

The contents of this bulletin are a compilation of data collected over a period of six years. Recognition is hereby given to the persons responsible for the major part of the work in each of the various years.

1949-50: Champagne, G. B., H. E. Hathaway, A. B. Watts and C. W. Upp.
1951 : Hathaway, H. E., A. B. Watts and C. W. Upp.
1952 : Hathaway, H. E.
1953-54: May, K. N., and C. W. Upp.

In addition to those listed there were numerous students, graduate students and staff members who assisted in making the actual measurements. Two masters theses, one technical publication and two popular articles have been written using various segments of the data. Titles and authors of these reports will be found in the bibliography.

Processing Losses and Meat Yields of Chickens of Broiler and Light Roaster Weights

By K. N. May

INTRODUCTION

During the period of expansion of the broiler industry many specialized broiler strains and crosses were developed. In the development of these strains emphasis was placed on such characteristics as rapid growth, fast feathering and feed conversion while relatively little or no selection has been practiced on processing loss and meat yield. In this highly competitive period, however, it is evident that the processor is greatly interested in reducing processing losses to a minimum. The difference of even one per cent in the yield of ready-to-cook weight between two strains can be of great economic significance when thousands of birds are processed each day.

The actual edible yield of different strains is of interest principally to the consumer. Since the consumer is the ultimate utilizer of poultry meat, it is of primary importance that he be pleased with the product. With these facts in mind work was begun in October 1949 at the Louisiana Agricultural Experiment Station at Baton Rouge to ascertain the differences in processing losses and meat yields of some of the more popular commercial breeds, strains and crosses and certain experimental strains and crosses developed at the station. These studies extended over a period of six years (1949-1954) and involved 1,110 chickens of broiler and light roaster weights. In this bulletin the editor has attempted a compilation of all these data, some of which have been reported in miscellaneous publications and some of which have not been reported previously.

REVIEW OF LITERATURE

Since there is no complete review of literature available in this field the compilator feels that a fairly complete and comprehensive review is justified in this publication. For the sake of clarity, works of a similar nature are grouped under various subheadings.

Processing Losses

Interest in processing losses of poultry has been evident for many years. Jull and Maw as early as 1923 reported the processing losses of various kinds of domestic birds. New York dressed weights were given as 88.3± .72 and 88.98± .22 per cent of live weight, respectively, for broilers and roasters. Limited data presented by Vernon (1923) showed the shrinkage* from live to New York dressed weight as 14.76 per cent for fryers, 10.70 per cent for roasters and 11.69 per cent for hens. Shrinkages from live to ready-to-cook weight were given as 18.54, 18.11 and 18.79 per cent of live weight, respectively, for the three classes. Maw (1933) reporting on egg strains and popular broiler strains of that time gave a much higher range in processing losses from live to ready-to-cook weight than did Vernon in 1923. Maw reported losses from live to ready-to-cook weights as 27.9 to 33.8 per cent of live weight.

Marsden (1937) gave the weight loss due to overnight fasting of Bronze turkeys as 3.34 per cent, with no significant difference due to age or sex. Shrinkages from starved live weight to New York dressed weight were shown to be 9.65 and 9.55 per cent of starved live weight for males and females, respectively. Weight loss from live weight to the ready-to-cook state were 23.18 per cent for males and 23.47 per cent for females. Large birds gave significantly higher ready-to-cook yields than did small birds. Harshaw and Rector (1940) reported on five age groups of turkeys ranging from 16 to 32 weeks of age and found the New York dressed weight to vary from 81.1 to 91.0 per cent of the live weight for both sexes. The older age groups gave the higher yields. Ready-to-cook weight as a percentage of live weight varied from 68.5± .44 to 75.0± .84 for the males, whereas it ranged from 68.4± .53 to 76.3± .20 for the females. The older age groups gave consistently higher yields except for the 16-week-old group of females, which yielded 70.1± .38 per cent of live weight. Working with different varieties and strains of turkeys, Harshaw *et al.* (1943) found that the relative dressed and drawn weights were somewhat higher in Broad-breasted Bronze than in Standardbred Bronze, White Holland and Beltsville Small White turkeys at 28 to 30 weeks of age.

Upp and associates (1954) reported on processing losses of Broad-breasted Bronze and Beltsville Small White turkeys taken over a seven-year period. They found the chilled New York dressed weight to be 89.9 per cent of live weight for Beltsville Small White males and 89.7 per cent of live weight for Beltsville Small White females. Bronze males and females gave New York dressed yields of 92.1 and 92.3 per cent, respectively, of live weight. The Bronze gave higher eviscerated yields (81.2 per cent of live weight for males and 81.5 per cent of live weight for females)than did the Whites (78.8 per cent of live weight for males and 78.4 per cent of live weight for females).

Jull *et al.* (1943) gave the first detailed report on processing losses of chickens. New Hampshire and New Hampshire x Barred Plymouth Rock crosses separated into two groups were used. Group I consisted of males having an average live weight of 1,368 grams. Group II was composed of two weight groups of males. The average live weight was 863 grams for one group and 1,034 grams for the other group. They reported a range in ready-to-cook yield of 67.3 to 70.2 per cent of live weight between the groups. The lightest birds gave the lowest yields. New York dressed weight ranged from 89.8 to 90.8 per cent of live weight. The heavier males of both groups gave higher yields than the females of Group I and the lighter males of Group II. Losses due to intestine weight varied from 8.0 to 10.1 per cent of live weight, with the lighter birds in Group II exhibiting the highest losses. Head weight was shown to vary from 4.1 to 4.9 per cent of live weight, with the least loss occurring in the females. Losses due to feet and shanks weight varied from 4.6 to 5.9 per cent of the live weight, with the females having the lowest loss due to this factor.

---

* The term shrinkage as used by early workers included the loss of blood, feathers, viscera. etc. as well as moisture losses.

Newell and Shaffner (1950) concluded that blood loss during the processing was more closely associated with total blood volume than with the body weight. They reported that chickens lost 35 to 50 per cent of the total blood of the body during the bleeding phase of the killing operation. This amounted to about 4 per cent of the live weight in broilers.

It is apparent from the survey of literature on processing losses that additional information is needed. Although it has been established that larger birds give superior yields, the reasons for these differences have not been determined. In addition the differences in yield due to sex need further investigation.

Edible Meat Yield as Related to Specific Body Measurements

There have been many attempts to correlate edible meat yield of various types of poultry with specific body measurements.

Jaap and Penquite (1938) demonstrated that four linear measurements—shank length, keel length, anterior body depth and width of breast—along with the cube root of the body weight were positively related to the visual classification or "grade" of dressed chickens and turkeys. Maw and Maw (1939), working with Barred Plymouth Rocks, Rhode Island Reds and crosses between those breeds, found that increased length and depth of body were associated with increased gains in body weight, and that birds with longer legs and keels had smaller gains in body weight. An increase in body length was shown to be associated with a decrease in edible flesh. Dolecek *et al.* (1949) noted that the thickness of cervical and pectoral feather tracts had a direct relationship to the fat content of the total edible meat of roasters. They reported significant correlations between breast volume and weight of total edible meat and between fleshing index and total edible meat. A method was given by Bird (1943) for accurate determination of fleshing index through logarithmic regression of body weight on tibia length. Jull *et al.* (1943) noted that long shanked New Hampshire cockerels gave greater breast meat yields than did short shanked cockerels. Frishknecht and Jull (1946) reported that live weight gave the best indication of breast meat yield. They found that Cornish and Cornish crossbreds had wider breasts and gave higher breast meat yields than non-

Cornish breeds and crossbreds, and that females yielded higher percentages of breast meat than did males. It was demonstrated by Bird (1944) that fleshing index was a good measure of fleshing in Beltsville Small White turkeys but not in other varieties. Berg and Shoffner (1954) concluded that body weight, independent of body conformation, was the most useful measure of meat yield for turkeys.

The limited information available shows promise of finding some live bird measurements by which meat yields can be predicted. Additional studies are needed in order to find the simplest possible measurements that can be of practical use.

Edible Meat Yield Obtained by Separating Raw Meat from Bone

Edible meat yields of poultry have been collected by two major methods—the mechanical separation of raw meat from bone and the separation of cooked flesh from bone after various methods of cooking. Jull and Maw (1923) reported the first work using raw weights. They reported edible meat yields as 54.27± .60 per cent of New York dressed weight and 49.92± .50 per cent of live weight for broilers. In view of later work these figures, as do those of many other earlier workers, appear to be too high. This was due, in most cases, to the fact that the birds were starved prior to slaughter and that some cartilage was included with edible meat. Maw (1933) observed that, of many stocks tested, the Leghorn breed gave the poorest yield (42.6 per cent of live weight). The Wyandotte breed gave the highest yield (47.7 per cent of live weight). Work by Harshaw (1936 and 1938) indicated that fattened cockerels gave lower breast meat yields than unfattened cockerels, while a greater total edible meat yield was obtained from fattened birds. Breast muscle was found to be 13.05 and 12.73 per cent of New York dressed weight and total edible meat weight was 52.30 and 55.28 per cent of New York dressed weight for unfattened and fattened cockerels, respectively. Maw and Maw (1939) showed edible meat weight (except neck and giblets) of 56.40 per cent for Barred Plymouth Rocks, 55.18 per cent for Rhode Island Reds and 53.23 per cent for Barred Plymouth Rock x Rhode Island Red crosses when expressed as a percentage of live weight. Extremely small numbers of birds were used in this experiment and yields given are extremely high. Heavier birds of both sexes gave higher yields than did lighter birds. Jull *et al.* (1943) noted a breast meat yield of 15.4 per cent of New York dressed weight for fryers with long shanks as compared with a yield of 14.6 per cent for fryers with short shanks.

Brown and Bean (1952) reported an average total meat yield of 50.3 per cent of live weight for five market classes of chickens. It was observed by Harshaw and associates (1943) that, on a percentage basis, Broad-breasted Bronze turkeys gave the highest yields of both breast and total edible meat, followed in order by birds of the Beltsville Small White, White Holland and Standardbred Bronze varieties. It was concluded by Bird (1944) that the average ratio of muscular tissue to the remainder of live, starved, body weight of turkeys increased from one variety to another as body weight increased. This relationship did not hold true between individuals within a variety.

Reports on meat yields of crossbred turkeys varying in age from 16 to 32 weeks by Harshaw and Rector (1940) showed a range in total edible meat yield of 50.9± 1.07 to 62.1± .44 per cent of New York dressed weight for males and 54.2± 1.27 to 64.4± .48 per cent of New York dressed weight for females.

Edible Meat Yield Obtained by Separating Cooked Meat and Bone

As early as 1923, Vernon reported on the cooked meat yield of fryers (fried), roasters (roasted) and hens (roasted), giving the edible meat yield as 35.56, 46.90 and 40.62 per cent of live weight, respectively, for the three classes. His results may be questioned since his data were collected from only four birds in each class and the cooking was done by individual housewives and not under controlled conditions. Lowe (1941) reported on edible meat yields for two weight classes of roasters. A yield of 34.0 per cent of New York dressed weight was obtained from the 43/47 pound class and a yield of 33.7 per cent of New York dressed weight was obtained from the 48/54 pound class. The method of cooking was roasting at 300° F. Alexander and Schopmeyer (1949) cooked hens by boiling and simmering and noted a total edible meat yield of 33.0 per cent of ready-to-cook weight (excluding giblets). No differences were found due to cooking method. McNally and Specknall (1949) reported extremely high edible meat yields (over 60 per cent of live weight) from Rhode Island Red males of broiler, fryer and roaster weights which had been boiled. Their method of measuring may be questioned because they calculated meat yield as the difference between raw ready-to-cook weight and cooked bone weight. Stotts and Darrow (1953), using methods similar to those of McNally and Specknall (1949), reported extremely high meat yields. Again this method of computing meat yield is questionable since cooked bone weight and raw carcass weights were compared. However, general trends in the results obtained agree with those of Hathaway (1952 and 1953) and Hathaway and coworkers (1953), taken from raw yields. All investigators found that Cornish gave the highest yields, Cornish crossbreds intermediate yields and non-Cornish pure-breds the lowest yields of edible meat.

Alexander *et al.* (1948) found that Beltsville Small White turkeys gave edible meat yields of 53 per cent of New York dressed weight as compared with a yield of only 47 to 48 per cent for Broad-breasted Bronze turkeys. They used roasting as the cooking method. It was concluded by Alexander and associates (1951) that age had a greater effect on cooked edible yields of turkeys than did cooking methods or raw carcass grades. The age group of 26 to 30 weeks gave the highest yields (38.5 to 41.9 per cent of New York dressed weight) of the groups tested. Swickard and Harkin (1954) found no significant differences in the total edible meat yield of young Beltsville Small White Turkeys. Total edible meat yields were found to be 53.9, 54.8 and 55.5 per cent of ready-to-cook weight (excluding neck and giblets), respectively, for toms 14 weeks of age, hens 16 weeks of age and toms 26 weeks of age. Bone weight was shown to range from 15.1 per cent of ready-to-cook weight (excluding neck and giblets) for the 26-week-old toms to 19.8 per cent of ready-to-cook weight (excluding neck and giblets) for the 14-week-old toms. Roasting was the cooking method used.

The large differences in percentage yields of edible meat reported by various authors indicate that more exacting studies involving larger numbers of birds are needed.

The experiments summarized in this bulletin were designed to supplement the existing knowledge by clearing up some of the deficiencies that have been pointed out. The objectives of the work were to determine existing differences in the commercial stocks, to develop some method of predicting yields by measurements on the live bird and to use the information thus attained in the testing and evaluation of experimental breeding stocks.

EXPERIMENTAL PROCEDURE

1949-50 Experiments

Lots of 100 birds of each breed were started on clean wood shavings under a natural gas or an electric hover. All groups were fed on the standard broiler ration used at the station. Essentially the same management was practiced on each group.

Birds for slaughter were selected at 12 weeks of age. Ten males and 10 females of each breed were used. Birds of each sex from each breed were selected as closely as possible to the composite mean of all breeds for each sex. The broilers selected for slaughter were held overnight without feed and weighed individually prior to killing. The birds were killed by the bleed and brain-stick method, semi-scalded for 25-35 seconds in water held between 128° and 130° F., rough picked on a mechanical picker, pinned by hand and singed in a gas flame. After the New York dressed weights were taken, the carcasses were cooled overnight in a dry air temperature of 40° F. Body measurements were then made on each individual bird. These measurements included the length of the keel, body depth and breast width. The breast width was determined as follows: First the average keel length of each sex for each breed was calculated. Then a solder wire was cut so that it was exactly half as long as the average keel length. This wire was shaped to the bird's breast at a point approximately one and one-half inches toward the rear of the keel from its anterior end. The straightline distance between the ends of the wire, after it had been shaped to the bird's breast, was considered to be breast width. A vernier caliper was used to measure breast width, body depth and keel length. In Trial 1 of 1949-50 the birds were deboned before evisceration while in Trials 2 and 3 they were eviscerated prior to deboning.

After all measurements had been made the carcasses were deboned while still in the raw state. Edible meat was carefully cut away from the bone and cartilage with a sharp knife. First the wings were removed from the carcass, then the breast meat was removed and kept separate from the remainder of the edible meat. The remainder of the edible meat (including in the case of the wings, only the humerus section) was carefully severed from bone and cartilage. Weights were taken of breast meat, total meat and bone plus cartilage.

1951 Experiment

In the 1951 experiment samples of birds from the National Chicken of Tomorrow Contest were used. The Chicken of Tomorrow broilers had been New York dressed before they were available for experimental use at this station.

Detailed records were kept of processing losses during this experiment. After New York dressed weights were obtained, the head was severed from the neck of each carcass by cutting through the atlas joint. The feet and shanks were separated from the carcasses by severing the hock joint. The neck was removed by splitting the skin along the dorsal side and severing the neck just anterior to the point at which it joins the body. The viscera and the giblets, after cleaning, were placed on absorbent paper towels for weighing. Net weights recorded during the processing procedure were New York dressed weight, head weight, feet and shanks weight, neck weight (without skin), viscera weight (included neck skin), giblet weight and total eviscerated weight (included neck and giblets).

The carcasses were deboned immediately after processing was completed. The same deboning procedures were followed as in the 1949-50 experiments.

1952 Experiments

Essentially the same brooding and management practices were exercised in these experiments as were exercised in the 1949-50 experiments described above.

In the 1952 experiments the birds were slaughtered when they reached a given weight rather than at a specific age. The broilers were weighed daily and birds were selected for slaughter when they reached a live weight of 2.0 pounds in one trial and 2.5 pounds in another trial. A total of ten birds of each sex from each breed was processed in each of the two trials. The birds were not starved prior to slaughter.

Killing procedures were the same as those described for the 1949-50 experiments. Detailed processing losses and meat yields were recorded as described for the 1951 experiment.

1953-54 Experiments

Brooding and management practices for these experiments were similar to those described for the 1949-50 experiments.

Ten males and a like number of females of each stock were selected at 10 weeks of age. This sample of each sex was selected from as near the mean weight of the respective sexes as possible. These samples were held (after 10 weeks) until the birds reached a live weight of 4.5 to 5.0 pounds for the males and 3.3 to 3.8 pounds for the females in one trial and 3.2 to 3.8 pounds for the males and 3.0 to 3.5 pounds for the females in two other trials.

Killing procedures were the same as those described for the 1949-50 experiments except that the birds were not starved prior to slaughter.

Raw edible meat yields were obtained in two trials by the same procedures as in the 1951 experiment. In addition to the raw yields, carcasses from one trial were cooked in steam retorts in order to obtain cooked meat yields. The carcasses, placed on metal racks with drip pans underneath, were assembled in tiers of two or three according to the capacity of the retort. A cooking time of 15 minutes at 15 pounds of pressure was used. After the required cooking time had elapsed, the steam was turned off and accumulated steam inside the retort was allowed to escape slowly. When steam pressure inside the retort reached zero pounds, the retort was opened and the racks of carcasses removed. A period of five to seven minutes was required for the pressure to reach zero pounds. After cooling and separation of edible parts, weights were taken of the total cooked eviscerated carcass (including neck and giblets), skin, breast meat, other meat, neck, neck meat, neck bone, giblets, bone plus cartilage and drip liquid.

Statistical Treatments

Appropriate statistical analyses were made of the data collected in each of the various years. Methods of Snedecor (1950) were used, and these tests included, where relevant, simple analysis of variance, analysis of covariance, simple correlations and multiple correlations.

RESULTS AND DISCUSSION

1949-50 Experiments

The results of Trials 1, 2 and 3, 1949-50, are presented in Tables 1, 3 and 5 of Appendix I. Detailed processing losses were not recorded in this series of trials, and only the live weight and meat yields are presented in the tables. Summaries of the statistical analyses of these trials will be found in Tables 2, 4 and 6, Appendix I. It may be noted, as expected, that the live weights of the males in all trials exceeded those of the females at 12 weeks of age. These differences proved highly significant* in all cases. In Trials 1 and 3 the live weights of the broiler strains were significantly higher than those of the non-broiler strains. There were no real differences in the live weights of breeds in Trial 2.

---

* The term "highly significant" throughout this manuscript will refer to probability at the .01 level while "significant" will refer to probability at the .05 level.

No significant differences were noted as to the percentage loss from live weight to New York dressed weight. New York dressed weights ranged from 87.8 to 90.7 and from 87.3 to 92.5 per cent of live weight for males and females, respectively. Eviscerated weights were not recorded in Trial 1. In Trial 2 the differences among lots with respect to eviscerated weight were not significant. However, the Dark Cornish, with an average eviscerated weight of 73.2 per cent of live weight, tended to yield a higher percentage than did the others. In Trial 3 statistical analysis of the eviscerated weights showed that the Dark Cornish yielded a significantly higher percentage of eviscerated weight on the basis of live weight (72.7 per cent) than did the White Plymouth Rocks (68.7 per cent). The Dark Cornish averaged significantly higher in eviscerated weights than did any of the other lots. Eviscerated weight expressed as a percentage of live weight for the New Hampshire A (71.1) and Crossbred B (71.3) was significantly greater than that of the New Hampshire B (69.7). In all three trials the females, with few exceptions, yielded higher percentages of edible meat than did the males, both on the basis of live weight and of eviscerated weight. These differences were not analyzed statistically. Frischknecht and Jull (1946) reported the same results in their studies with 12-week-old chickens. In all trials, the Dark Cornish yielded the highest percentage of total edible meat and of breast meat on the basis of live weight and of eviscerated weight. This agrees with results of Henderson (1950) in which he reported that Dark Cornish ranked highest in meat type score. The White Plymouth Rocks were second to the Dark Cornish in all trials, except in Trial 3, in which Crossbred B ranked second in meat yield.

In Table 7, Appendix I, are shown the average measurements for each lot for the three trials of 1949-50. Although the Dark Cornish were the lightest in live weight at 12 weeks of age, they had wider breasts than did the other lots. It should be noted that the keel length and body depth of the Dark Cornish were less than those of the other lots. The broiler type New Hampshires, although heaviest in live weight, had a narrower breast but a longer keel and a deeper body. Frischknecht and Jull (1946) reported that the mean breast widths were greater in the progeny of Dark Cornish males. Simple and multiple correlations of breast weight with keel length, body depth and breast width are shown in tabular form in Table 8, Appendix I. From this table it can be noted that breast weight is more highly correlated with breast width than is breast weight with either keel length or body depth. Asmundson (1944) found that breast width was the only measure needed to differentiate the yields expected from turkeys. The correlation of the three measurements, keel length, body depth and breast width, is somewhat, but not a great deal, higher than the simple association of breast width and breast weight. This indicates definitely that breast width is the best single measure for predicting breast weight, and that using other measurements in addition may not be worthwhile. The regression of breast yield on breast width is shown for males and females in Figures 1 and 2, Appendix II.

1951 Experiment

The results of the 1951 experiment using birds from the National Chicken of Tomorrow Contest are summarized in Table 9, Appendix I. Summaries of the analysis of variance of these data are presented in Tables 10 through 16, Appendix I. It will be noted that there was very little variation in eviscerated weight as a percentage of New York dressed weight among the various breeds. Statistical analysis showed no real differences among pens within any of the breeds or among any of the breeds studied. Eviscerated weight as a percentage of New York dressed weight was found to be greater for the females than for the males in all breeds. This difference was found to be highly significant in all breeds except the New Hampshires and the miscellaneous breeds. In the New Hampshire breed the females gave a significantly greater (but not highly significant) eviscerated yield than did the males. No real differences in eviscerated yields were found between the sexes in the miscellaneous breeds, probably because of the large variation in the groups included in that classification. The average eviscerated yield as a percentage of New York dressed weight for all breeds tested was 79.5 and 81.5 per cent for the males and females, respectively. Head weight as a percentage of New York dressed weight was found to vary only by 0.7 per cent among males of the different breeds and 0.2 per cent among females of the different breeds. The differences of head weight among pens within a breed were not significant except for the "other New Hampshire crosses" and miscellaneous breeds. The "other New Hampshire crosses" showed significant differences in head yield among pens within the classification, while pens within the miscellaneous classification differed at the highly significant level. Again this significance was probably due to the wide variety of breeds and strains included in those arbitrary groups. The average head weight for males of all breeds was 4.0 per cent of New York dressed weight while that of the females was 3.6 per cent of New York dressed weight. The greater percentage head weight of the males over that of the females was found to be highly significant in all breeds except the two Cornish crossbred classes. No real differences between sexes were noted in the percentage head weights in either the Cornish x White Plymouth Rock or the Cornish x New Hampshire crossbred. This is to be expected since the pea comb and small wattles of Cornish crossbreds tend to increase the uniformity of head size and type between the sexes.

No real differences were noted among pens within a breed as to feet and shanks weight as a percentage of New York dressed weight except in the case of the New Hampshires, which exhibited highly significant differences among pens, and the White Plymouth Rocks, which showed significant differences among pens. The feet and shanks weight of the males expressed as a percentage of New York dressed weight was greater than that of the females in every breed. In this respect it followed the same pattern as head weight. These differences in feet and shanks weight between sexes proved highly significant in all breeds except the Cornish x White Plymouth Rock, where the differences were significant.

No real differences were found among pens within a breed in any of the groups used when viscera weight as a percentage of New York dressed weight was considered. The only breed that showed significant sex differences with respect to viscera weight was the New Hampshires, where there is reason to doubt the validity of the data when the viscera weights of the males (7.6 per cent) are so much lower than those of the females (8.3 per cent). From examination of the records it appeared that a mistake could have been made when viscera weights were recorded for that particular breed.

Breast meat yield as a percentage of eviscerated weight was found to average 17.8 per cent for males and 19.2 per cent for females. The difference in breast weight between sexes within breeds was highly significant in every case except for the Cornish x White Plymouth Rock, which exhibited no real differences in breast yield between sexes. The White Plymouth Rock breed was found to differ significantly among pens within the breed but there were no real differences among pens in the other breeds. The New Hampshire and "other New Hampshire crosses" proved to have lower breast yields (18.1 and 17.8 per cent) than did other breeds. These differences were highly significant. No differences in breast yield were noted among the White Plymouth Rock, Cornish x White Plymouth Rock, Cornish x New Hampshire and miscellaneous breeds.

Yields of total edible meat were very uniform both among breeds and among pens and sexes within a breed. There were no significant differences noted for meat yield as a percentage of eviscerated weight. However, the same trends were noted as in the 1949-50 experiments. The females in all cases tended to produce higher yields of edible meat on a percentage basis and the Cornish crossbreds tended to produce higher yields than the other strains studied.

1952 Experiments

The results of the 1952 experiments using broilers of 2.0 and 2.5 pounds live weight are presented in Tables 17 and 18, Appendix I. Since some of the original raw data were not available from these experiments, it was impossible for the compilator to analyze the results. For this reason only a few of the general trends will be pointed out here. As shown in the tables, the heavier birds within sexes averaged higher eviscerated weights (66.2 and 67.0 per cent of live weight for males and females, respectively) than did the lighter weight group (64.3 and 64.8 per cent of live weight for males and females, respectively). In this respect the results agree with those of Jull *et al.* (1943), who reported that light birds gave lower eviscerated weights as a percentage of live weight than did birds in a heavier weight class. The Dark Cornish breed gave higher eviscerated yields than did the other breeds and crosses studied in both weight classes. The Dark Cornish also tended to give greater breast yields and total meat yields as a percentage of eviscerated weight than did the other breeds. This was especially true in the heavier weight class.

1953-54 Experiments

A summary of the processing weights obtained in the 1953-54 experiments may be seen in Tables 19 through 22, Appendix I. The New York dressed yield of males varied between 87.2 and 88.3 per cent of live weight, and the New York dressed weight of the females was slightly less than that of the males of each stock tested. An actual difference was not found among the various stocks tested in either sex. The White Plymouth Rock x New Hampshire females gave lower yields (86.8 per cent) than did the White Cornish females (87.7 per cent).

The differences in yield of total eviscerated weight (including neck and giblets) among breeds was found to be highly significant for both males and females. White Cornish males and females, with eviscerated weight yields of 69.3 and 69.9 per cent of live weight, respectively, produced significantly higher yields than White Plymouth Rock x New Hampshire males and females with yields of 67.5 per cent of live weight.

Differences in processing losses due to head weight were found to vary within narrow limits (0.2 per cent of live weight) among males of the different breeds. This difference was not significant. Head weight was found to be 3.6 to 3.8 per cent of the live weight for males. Females had less percentage loss due to head weight than did the males. This is to be expected because of the larger combs and more massive heads of the males. The average female head weight was 0.4 per cent less than that of males of the same stock. A highly significant difference due to head weight was found among the females of the different stocks. The White Plymouth Rock x White Cornish and White Plymouth Rock x (White Wyandotte x White Cornish) exhibited the highest losses due to head weight (3.3 per cent) and the White Plymouth Rock x New Hampshire exhibited the smallest losses (3.1 per cent). It is of interest to note that a very small variation of 0.2 per cent of live weight among head weights of the different stocks resulted in a highly significant difference in the females and no significant difference in the males. This can be explained by the fact that the females had less variation as to head weight within breeds than did the males.

Feet and shanks weights showed no significant variation among males of the different breeds. The males averaged 1.1 per cent greater feet and shanks weight than did the females. Despite the small variation in feet and shanks weight of the females (only 0.3 per cent of live weight), the differences among breeds were highly significant. As in the case of head weight, this can be explained since the females showed less variation in feet and shanks weight within breeds than did the males.

Highly significant differences were noted among breeds for both sexes for viscera weight expressed as a percentage of live weight. The White Cornish females exhibited the smallest viscera loss (9.7 per cent) in the female sex. The White Plymouth Rock x (White Wyandotte x White Cornish) males gave the lowest losses (9.2 per cent) in the male sex. Differences among breeds for giblet and neck weights were highly significant for males but were not significant for females.

The raw edible meat yields and bone plus cartilage losses for the 1953-54 experiments are summarized in Table 20, Appendix I. The White Cornish gave the highest breast yield as a percentage of eviscerated weight (18.9 per cent for males and 21.5 per cent for females) of any of the breeds tested. These yields were greater at a highly significant level than those of the White Plymouth Rock x New Hampshire (16.9 per cent for males and 19.1 per cent for females). There were no real differences in "other meat" yields among breeds in either sex. However, there were significant differences in bone weight as a percentage of eviscerated weight among males of the various breeds and highly significant differences among females of the different breeds. In both sexes the White Plymouth Rock x New Hampshire gave the greatest losses due to bone weight.

These results present the same picture as the previous experiments, in that the Cornish and Cornish crossbred stocks gave higher eviscerated weight and greater meat yield than did other purebred stocks and crossbreds. In addition these experiments point out the fact that the increased meat yield of the Cornish stocks was due to greater breast and giblet yield and less loss due to bone weight.

In Table 21, Appendix I, is presented a summary of cooking losses and cooked edible meat yield for the 1953-54 experiments. These data were not analyzed statistically and will not be discussed in detail here. It should be noted that the same general trends in yield were obtained as in the raw yield data. The only factor of especial interest is that of bone yield, which was only 18.8 and 18.0 per cent of raw eviscerated weight for males and females, respectively. It can be seen in Table 20, Appendix I, that the raw bone yield was 38.9 and 36.2 per cent of eviscerated weight, respectively. This large difference in raw and cooked bone yield tends to invalidate the large edible yields reported by McNally and Specknall (1949), Stotts and Darrow (1953) and others who calculated meat yield as the difference between cooked bone weight and raw eviscerated weight.

A summary of the statistical analyses of the 1953-54 experiments is presented in Table 22, Appendix I.

SUMMARY AND CONCLUSIONS

During a period of six years (1949-54) 1,110 chickens of broiler and light roaster weights were slaughtered and detailed records kept of processing losses, raw edible yields, some cooked edible yields and certain carcass measurements. Observations made and conclusions reached are summarized below.

1. At 12 weeks of age male broilers were heavier than female broilers.
2. At a given weight, females gave greater eviscerated weights as a percentage of live weight than did males.
3. At a given weight, females gave significantly larger breast meat and total edible meat yields as a percentage of eviscerated weight than did males.
4. The greatest breast and total edible meat yields as a percentage of eviscerated weight were given by the Cornish breed, intermediate yields by Cornish crossbreds and the lowest yields by breeds and crossbreds not containing Cornish.
5. From analyses, differences in total edible meat yield were indicated to be due to breast yield, giblet yield and bone losses and not due to "other meat" yields.
6. Body measurements indicated that Cornish broilers, although smaller in live weight at 12 weeks, had the greatest breast width of any breed studied. The keel length and body depth of the Cornish, however, were the smallest of the breeds studied.
7. Statistical analysis indicates that breast width is the best single measure for predicting percentage breast meat and total edible meat yields in 12-week-old broilers. Other measures used were body depth and keel length.
8. Differences in raw and cooked bone weights indicate that edible yields calculated as the difference between cooked bone weight and raw eviscerated weight are invalid.

BIBLIOGRAPHY

Alexander, L M., and G. E. Schopmeyer, 1949. Yield of edible portion of chicken and various meats cooked by different home methods. *Food Technol.* 3 (8) : 263-268.

Alexander, L. M., G. E. Schopmeyer, J. C. Lamb and S. J. Marsden, 1951. Yield of cooked edible portion of turkey according to sex, age, fatness, and type. *Poultry Sci.* 30 (2) : 187-195.

Alexander, L. M., G. E. Schopmeyer and S. J. Marsden, 1948. Yield of cooked edible portion of young roasted turkey. *Poultry Sci.* 27 (5) : 579-587.

Berg, R. W., and R. N. Schoffner, 1954. The relationship between body measurements and meat yield in turkeys. Abstract of paper presented at the 43rd annual meeting of the Poultry Science Association. *Poultry Sci.* 33:1042.

Bird, S., 1943. Determination of fleshing characteristics in market poultry. I. Chickens. *Sci. Agr.* 24 (3) :135-144.

Bird, S., 1944. Determination of fleshing characteristics in market poultry. II. Turkeys. *Sci. Agr.* 24 (10) :481-488.

Bird, S., 1945. Measuring roundness of breast in live turkeys. *U.S. Egg & Poultry Mag.* 51:206-209.

Bird, S., 1948. Quantitative determination and segregation of breast conformation in poultry. *Poultry Sci.* 27 (4) : 506-508.

Broadbent, M., and H. W. Bean, 1952. The yield of edible meat from turkeys, ducklings, and different market classes of chickens. *Poultry Sci.* 31 (3) :447-450.

Brown, P. B., and H. W. Bean, 1952. The yield of edible meat from different classes of chickens. *Poultry Sci.* 31 (2) :232-234.

Champagne, G. B., 1951. Meat yields of broilers of different breeds, strains and crosses. *A thesis. Louisiana State University.*

Collins, W. M., C. I. Bliss and H. M. Scott, 1950. Genetic selection for breast width in a strain of Rhode Island Reds. *Poultry Sci.* 29:881-887.

Dolecek, R. L., W. O. Wilson and W. E. Poley, 1941. Physical measurements of carcass quality in roasters. *Poultry Sci.* 20 (2) : 161-170.

Frishknecht, C. O., and M. A. Jull, 1946. Amount of breast meat and live and dressed grades in relation to body measurements in 12 week old purebred and crossbred chickens. *Poultry Sci.* 25 (4) :330-345.

Hafez, E. S. E., 1955. Differential growth of organs and edible meat in the domestic fowl. *Poultry Sci.* 34 (4) :745-753.

Harshaw, H. M., 1936. Effect of diet, range, and fattening on the physical and chemical composition of cockerels. *J. Agri. Res.* 53:357-368.

Harshaw, H. M., 1938. The effect of fattening at different ages on the composition of cockerels. *Poultry Sci.* 17 (2) :163-169.

Harshaw, H. M., 1943. Weights of parts and per cent edible meat obtained from cut up chickens. *U.S. Egg & Poultry Mag.* 49:405-407, 432.

Harshaw, H. M., and R. R. Rector, 1940. The composition of turkeys as affected by age and sex. *Poultry Sci.* 19 (6) :404-411.

Harshaw, H. M., W. L. Kellogg, R. R. Rector and S. J. Marsden, 1943, The composition of turkeys of different varieties and strains. *Poultry Sci.* 22:126-136.

Hathaway, H. E., 1952. Test shows possibilities of improving meat yields. Birds from 1951 National C. O. T. used in Louisiana experiment. *Broiler Growing* 3 (10) : 46-48.

Hathaway, H. E., 1953. Comparing processing yields of various broiler strains (preliminary report) . *The Southeastern Poultryman* 6 (1) :39, 113-115.

Hathaway, H. E., G. B. Champagne, A. B. Watts and C. W. Upp, 1953. Meat yield of broilers of different breeds, strains and crosses. *Poultry Sci.* 32 (6) :968-977.

Henderson, E. W., 1946. Percentage of edible meat in relation to meat type score of chickens. *American Egg & Poultry Review.* 7:44.

Henderson, E. W., 1950. Breed differences in meat type score and weight of 12 week old cockerels. *Mich. Agr. Exp. Sta. Quart. Bul.* 32:507-512.

Hoffman, E., 1943. White Cornish-White Rock cross proves superior broiler stock. *U.S. Egg & Poultry Mag.* 49:368-369, 381.

Jaap, R. G., 1941. Body form in growing chickens. *J. Agr. Res.* 62:431-443.

Jaap, R. G., M. M. Renard and R. D. Buckingham, 1950. Dressed and eviscerated meat yields from chickens at 12 weeks of age. *Poultry Sci.* 29:874-880.

Jaap, R. G., and R. Penquite, 1938. Criteria of conformation in market poultry. *Poultry Sci.* 17 (5) :425-430.

Jull, M. A., and W. A. Maw, 1923. Determinations of the dressed, drawn and edible percentage of various kinds of domestic birds. *Sci. Agr.* 3:329-339.

Jull, M. A., R. E. Phillips and C. S. Williams, 1943. Meat contributed by breast, humeri, and legs of fryers in relation to shank length. *U.S. Egg & Poultry Mag.* 49:364-365.

Lowe, B., 1941. Edible meat from two weights of roasters comparing yields from forty-three to forty-seven pound and forty-eight to fifty-four pound classes of roasters. *U.S. Egg & Poultry Mag.* 47 (2) :95-102.

McNally, E. H., and N. H. Specknall, 1954. Meat yield from live, dressed and eviscerated Rhode Island Red males of broiler, fryer and light roaster weights. *Poultry Sci.* 28 (4) :562-567.

Marsden S. J., 1937. Dressing shrinkages of Bronze Turkeys. *Poultry Sci.* 16 (2) :112-117.

Maw, A. J. G., and W. A. Maw, 1939. The relationship of body measurements to the fattening gains and the percentage of edible meat in the fowl. *Sci. Agr.* 19:589-596.

Maw, W. A., 1933. Meat production in poultry. *U. S. Egg & Poultry Mag.* 39 (7) :18-47.

May, K. N., 1955. Processing losses and meat yields of four crossbred broiler stocks. *A Thesis. Louisiana State University.*

Newell, G. W., and C. S. Shoffner, 1950. Blood loss by chickens during killing. *Poultry Sci.* 29 (2) :271-275.

Scott, H. M., 1954. Checking market grades with meat measurements. *U. S. Egg & Poultry Mag.* 51:340-343.

Snedecor, G. W., 1950. *Statistical Methods.* Iowa State College Press, Ames, Iowa.

Snyder, E. S., and H. L. Orr, 1953. Market possibilities and yields of goslings dressed at various ages. *Poultry Sci.* 32 (1) :181-182.

Stotts, C. E., and M. I. Darrow, 1953. Yields of edible meat from Cornish crossbreds, and purebred broilers. *Poultry Sci.* 32 (1) :145-150.

Upp, C. W., J. L. Heath, and R. S. Woodward, 1954. Growing market turkeys in Louisiana. *La. Agr. Expt. Sta. Bul.* 487:1-20.

Vernon, W. M., 1923. Losses sustained in preparing poultry for the table. *Poultry Sci.* 3 (6) :187-193.

APPENDIX I

TABLE 1.—Summary of Results of Trial 1, 1949-50

Breed	Sex*	Live weight (grams)	N. Y. dressed weight as % of live weight	Total edible** weight as % of live weight	Breast yield as % of live weight
Dark Cornish	Males	1418	90.1	35.1	13.7
	Females	1179	89.7	36.1	15.2
	Both Sexes	1299	89.8	35.6	14.5
White Plymouth Rocks	Males	1373	89.6	33.0	12.7
	Females	1079	89.9	31.4	13.1
	Both Sexes	1226	89.7	32.2	12.9
New Hampshire B Strain	Males	1900	89.0	27.4	10.6
	Females	1426	88.0	29.2	11.4
	Both Sexes	1663	88.3	28.3	11.0
New Hampshire A Strain	Males	1882	89.5	31.8	12.1
	Females	1414	90.4	32.7	13.1
	Both Sexes	1648	89.9	32.3	12.6
Production Strain New Hampshires	Males	1501	88.7	30.3	11.3
	Females	1226	88.5	32.8	12.8
	Both Sexes	1364	88.6	31.6	12.1
Crossbred A	Males	1706	88.8	30.7	11.4
	Females	1357	88.3	32.0	12.8
	Both Sexes	1532	88.6	31.4	12.1

* These results are the average of 10 males, 10 females and the 20 of both sexes of these breeds.

** Total edible weight does not include neck meat or giblets.

TABLE 2.—A summary of the results of the statistical analysis of Trial 1, 1949-50

Comparison	Total edible weight as % of live weight	Breast weight as % of live weight
	F value	F value
Production vs Broiler Strains	51.1**	57.9**
Dark Cornish vs W. P. Rock	24.6**	19.1**
Broiler N. Hamps. vs Crossbreds	4.2*	.5
Broiler N. Hamps. A vs Broiler N. Hamps. B	29.7**	15.1**
Crossbred B vs Crossbred A	.9	.03

* F value beyond .05, significant.

** F value beyond .01, highly significant.

TABLE 3.—Summary of results of Trial 2, 1949-50

Breed	Sex*	Live weight (grams)	New York dressed weight	Eviscerated weight	Total edible** weight as % of		Breast yield as % of	
			As % of live wt.		Live weight	Eviscerated weight	Live weight	Eviscerated weight
Dark Cornish	Males	1325	90.7	72.8	35.2	48.3	13.2	18.2
	Females	1079	90.2	73.7	37.5	50.9	14.6	19.8
	Mean	1202	90.5	73.2	36.4	49.6	13.9	19.0
White Plymouth Rocks	Males	1315	90.1	71.2	33.6	47.2	13.0	16.9
	Females	1083	88.1	68.1	32.8	48.1	12.5	18.3
	Mean	1199	89.2	69.8	33.2	47.7	12.8	17.6
New Hampshire B Strain	Males	1357	89.2	69.5	30.7	44.2	10.7	15.4
New Hampshire A Strain	Males	1312	88.6	68.4	28.8	42.1	10.3	15.0
	Females	1079	92.5	69.2	30.4	43.9	11.4	16.5
	Mean	1195	90.5	68.8	29.6	43.0	10.9	15.8
Crossbred B	Males	1343	90.1	70.2	31.9	45.9	11.0	15.9
	Females	1180	92.5	71.9	34.2	47.8	12.8	17.9
	Mean	1262	91.2	71.0	33.1	46.9	11.9	16.9
Crossbred A	Males	1369	89.4	71.6	31.7	44.2	11.1	15.5
	Females	1058	87.8	70.0	31.3	44.7	12.0	17.1
	Mean	1214	88.6	70.9	31.5	44.5	11.6	16.3

* These results are the average of 10 males, 10 females, and 20 males and females of these breeds.

** Total edible weight does not include neck meat or giblets.

TABLE 4.—A summary of the results of the statistical analysis of Trial 2, 1949-50

Comparison	Total edible weight as % of		Breast weight as % of	
	Live weight	Eviscerated weight	Live weight	Eviscerated weight
	F value	F value	F value	F value
Production vs Broiler Strains	24.8**	43.6**	103.1**	63.7**
Dark Cornish vs. W. P. Rocks	8.6**	2.2	39.9**	14.0**
Broiler N. Hamps. vs Crossbreds	8.1**	7.3**	17.9**	1.3
Broiler N. Hamps. A vs Broiler N. Hamps. B	2.2	3.8	2.1	11.2**
Crossbreds B vs Crossbreds A	3.8	7.7**	5.4*	5.3*

* F value beyond .05, significant.

** F value beyond .01, highly significant.

TABLE 5.—Summary of results of Trial 3, 1949-50

Breed	Sex*	Live weight (grams)	New York dressed weight	Eviscerated weight	Total edible** weight as % of		Breast yield as % of	
			As % of live wt.		Live weight	Eviscerated weight	Live weight	Eviscerated weight
Dark Cornish	Males	1311	90.7	73.4	35.1	47.8	13.5	18.4
	Females	976	90.1	71.8	35.3	49.1	14.6	20.3
	Mean	1144	90.4	72.7	35.2	48.5	14.1	19.4
White Plymouth Rocks	Males	1228	88.9	69.1	30.6	44.3	11.3	16.3
	Females	1066	87.3	68.3	30.9	45.2	12.1	17.7
	Mean	1147	88.2	68.7	30.8	44.8	11.7	17.0
New Hampshire B Strain	Males	1534	89.4	69.8	30.0	43.0	11.2	16.1
	Females	1152	87.9	69.6	31.0	44.6	12.4	17.7
	Mean	1343	88.8	69.7	30.5	43.8	11.8	16.9
New Hampshire A Strain	Males	1591	90.3	71.3	31.0	43.5	11.6	16.3
	Females	1286	88.5	70.9	32.6	46.2	12.7	18.0
	Mean	1439	89.5	71.1	31.8	44.9	12.2	17.2
Crossbred B	Males	1713	88.7	70.9	33.7	47.5	12.1	17.1
	Females	1337	89.9	71.8	35.5	49.1	14.6	20.3
	Mean	1525	89.3	71.3	34.5	48.3	13.4	18.7
Crossbred A	Males	1642	87.8	68.3	30.3	44.4	11.0	16.1
	Females	1208	88.2	69.9	31.2	44.6	12.1	17.3
	Mean	1425	88.0	69.0	30.8	44.5	11.6	16.7

* These results are the average of 10 males, and 10 females, and 20 males and females of these breeds.

** The edible weight does not include neck meat or giblet weight.

TABLE 6.—A summary of the results of the statistical analysis of Trial 3, 1949-50

Comparison	Total edible weight as % of		Breast weight as % of	
	Live weight	Eviscerated weight	Live weight	Eviscerated weight
	F value	F value	F value	F value
Production vs. Broiler Strains	14.5**	13.3**	9.3**	8.0**
Dark Cornish vs. W. P. Rocks	87.4**	36.5**	48.0**	25.3**
Broiler N. Hamps. vs. Crossbreds	18.1**	24.7**	4.1*	4.2*
Broiler N. Hamps. A vs. Broiler N. Hamps. B	7.5**	4.2*	1.1	.2
Crossbreds B vs. Crossbreds A	61.9**	38.3**	28.9**	18.5**

* F value beyond .05, significant.

** F value beyond .01, highly significant.

TABLE 7.—Average dressed measurements* of male and female 12-week-old broilers, 1949-50

Breed	Trial 1			Trial 2			Trial 3		
	Keel length	Body depth	Breast width	Keel length	Body depth	Breast width	Keel length	Body depth	Breast width
Dark Cornish	9.4	9.6	3.6	9.4	9.6	3.4	9.3	10.2	3.0
White Plymouth Rocks	10.0	10.0	3.2	9.6	10.0	2.9	10.0	11.0	2.5
New Hampshire B	10.4	10.7	3.4	10.5**	10.4**	2.8**	10.2	10.7	2.7
New Hampshire A	11.0	11.0	3.5	9.7	10.0	2.8	10.4	11.5	2.9
Egg Strain N. H.	9.4	10.2	3.1						
Crossbred B				9.8	10.1	3.0	10.6	11.6	3.2
Crossbred A	9.5	9.7	3.4	9.6	9.8	2.9	10.3	10.8	2.9

* Centimeters.

** No females are included in this group.

TABLE 8.—Correlation of breast weight with keel length, body depth and breast width, 1949-50

Breast weight Y	Keel length X_1	Body depth X_2	Breast width X_3	
		Males		
Correlation Breast Weight X	.4673	.4355	.6442	
Standard Regressions	.1091	.4021	.6505	R= .8032
		Females		
Correlation Breast Weight X	.2992	.2544	.4634	
Standard Regressions	.4569	−.1138	.5448	R= .6002

TABLE 9.—1951 Chicken of Tomorrow summary of processing losses and meat yields

	No. pens	Sex	N.Y. d. wt.* (grams)	Evisc** wt. as % N.Y. d. wt.	Head as % N.Y. d. wt.	Feet & shanks as % N.Y. d. wt.	Giblet as % N.Y. d. wt.	Viscera as % N.Y. d. wt.	Breast meat as % evisc. wt.	Total edible meat*** as % evisc. wt.
New Hampshire	9	M	1727	79.8	4.2	5.8	4.9	7.6	17.3	52.1
		F	1361	81.8	3.6	5.0	5.5	8.3	18.8	53.2
W. P. Rock	6	M	1693	79.2	3.7	6.3	5.4	8.2	18.3	52.9
		F	1253	81.9	3.6	5.4	6.2	9.2	19.4	53.2
Cornish x W. P. Rock	2	M	1589	79.1	3.7	5.8	5.3	9.1	19.0	54.4
		F	1238	82.4	3.6	4.9	6.2	9.3	20.5	54.0
Cornish x N. Hamps.	6	M	1841	79.9	3.6	5.4	4.9	8.2	18.0	52.7
		F	1430	81.3	3.5	4.7	5.5	7.7	19.6	54.1
Other N. Hamps. Crosses	4	M	1784	78.7	4.3	5.7	5.3	8.8	17.1	52.9
		F	1289	80.6	3.7	5.0	5.9	9.1	18.5	53.7
Misc. Breeds	4	M	1691	79.2	3.9	5.8	5.4	8.4	17.9	52.6
		F	1322	81.2	3.5	4.8	5.8	8.9	19.4	53.9
All Breeds	31	M	1748	79.5	4.0	5.8	5.1	8.2	17.8	52.7
		F	1322	81.5	3.6	5.0	5.8	8.6	19.2	53.6

* Live weight was not available.
** Eviscerated weight includes giblet and neck weights.
*** Total edible weight includes giblet but not neck meat.

TABLE 10.—1951 Chicken of Tomorrow experiment results of analysis of variance of head weight as a per cent of New York dressed weight

Breed	No. pens	No. birds	Source of variation		
			Mean square		
			Pen	Sex	Pen x Sex
New Hampshire	9	90	0.29	6.10**	0.46**
W. Plymouth Rock	6	60	0.06	0.70**	0.08
Cornish x W. Plymouth Rock	2	20	0.02	0.07	0.10
Cornish x New Hamp.	6	60	0.12	0.20	0.06
Other N.H. Crosses	4	40	0.50*	3.00**	0.30
Misc. Breeds	4	40	0.07**	1.20**	0.13**

* Significant at .05 level. ** Significant at .01 level.

TABLE 11.—1951 Chicken of Tomorrow experiment results of analysis of variance of feet and shanks weight as a per cent of New York dressed weight

Breed	No. pens	No. birds	Source of variation		
			Mean square		
			Pens	Sex	Pen x Sex
New Hampshire	9	90	0.44**	9.20**	0.91**
W. Plymouth Rock	6	60	0.38*	13.80**	0.34*
Cornish x W. P. Rock	2	20	0.00	4.00*	0.20
Cornish x New Hamp.	6	60	0.24	8.60**	0.08
Other N. H. Crosses	4	40	0.07	5.30**	0.07
Misc. Breeds	4	40	0.30	9.90**	0.03

* Significant at .05 level. ** Significant at .01 level.

TABLE 12.—1951 Chicken of Tomorrow experiment results of analysis of variance of viscera weight as a per cent of New York dressed weight

Breed	No. pens	No. birds	Source of variation		
			Mean square		
			Pens	Sex	Pen x Sex
New Hampshire	9	90	1.05	4.00*	1.95*
W. Plymouth Rock	6	60	1.30	10.50	0.72
Cornish x W. P. Rock	2	20	0.00	0.10	0.60
Cornish x New Hamp.	6	60	4.20	1.90	2.76
Other N. H. Crosses	4	40	1.67	1.40	0.93
Misc. Breeds	4	40	0.07	3.10	1.03

* Significant at .05 level.

TABLE 13.—1951 Chicken of Tomorrow experiment results of analysis of variance of total eviscerated weight as a per cent of New York dressed weight

Breed	No. pens	No. birds	Source of variation		
			Mean square		
			Pens	Sex	Pen x Sex
New Hampshire	9	90	11.70	179.20*	20.70
W. Plymouth Rock	6	60	6.32	64.70**	3.00
Cornish x W. P. Rock	2	20	3.70	50.30**	2.00
Cornish x New Hamp.	6	60	2.18	30.80**	1.34
Other N. H. Crosses	4	40	4.37	40.40**	3.23
Misc. Breeds	4	40	17.40	120.80	3.43

* Significant at .05 level. ** Significant at .01 level.

TABLE 14.—1951 Chicken of Tomorrow experiment results of analysis of variance of giblets as a per cent of eviscerated weight

Breed	No. pens	No. birds	Source of variation Mean square Pens	Sex	Pen x Sex
New Hampshire	9	90	2.24*	8.51**	0.80
W. Plymouth Rock	6	60	0.96	9.96	1.55
Cornish x W. P. Rock	2	20	0.21	4.68*	0.02
Cornish x New Hamp.	6	60	0.26	9.29**	0.32
Other N. H. Crosses	4	40	1.19	4.35	0.26
Misc. Breeds	4	40	2.33*	1.58	0.58

* Significant at .05 level.
** Significant at .01 level.

TABLE 15.—1951 Chicken of Tomorrow experiment results of analysis of variance of breast meat as a per cent of eviscerated weight

Breed	No. pens	No. birds	Source of variation Mean square Pens	Sex	Pen x Sex
New Hampshire	9	90	2.40	43.92**	1.24
W. Plymouth Rock	6	60	6.71*	26.44**	0.86
Cornish x W. P. Rock	2	20	3.83	10.97	17.87
Cornish x New Hamp.	6	60	1.34	37.30**	1.60
Other N. H. Crosses	4	40	1.44	17.49**	6.95*
Misc. Breeds	4	40	2.70	20.11**	1.41

* Significant at .05 level.
** Significant at .01 level.

TABLE 16.—1951 Chicken of Tomorrow experiment results of analysis of variance of total edible meat as a per cent of eviscerated weight

Breed	No. pens	No. birds	Source of variation Mean square Pens	Sex	Pen x Sex
New Hampshire	9	90	4.63	10.44	9.68
W. Plymouth Rock	6	60	13.75	0.08	6.74
Cornish x W. P. Rock	2	20	8.14	4.33	6.88
Cornish x New Hamp.	6	60	3.47	11.60	6.40
Other N. H. Crosses	4	40	1.18	2.10	35.22*
Misc. Breeds	4	40	4.10	10.69	5.22

* Significant at .05 level.

TABLE 17.—Summary of 1952 experiment using broilers of 2.0 pounds live weight*

Breed	Sex	Live weight (grams)	N. Y. d. as % live weight	Evisc. wt. as % live weight**	Head as % live weight	Feet & shanks as % live wt.	Giblets as % live weight	Viscera as % live wt.	Breast meat as % evisc. weight	Total*** edible meat as % evisc. weight
Crossbreed 1	M	912	87.6	64.7	3.4	4.6	5.8	12.2	13.4	46.3
	F	904	86.5	66.5	3.3	4.2	5.6	10.2	14.8	47.5
Crossbreed 2	M	900	87.3	65.7	3.6	4.7	5.7	10.8	13.3	46.5
	F	904	87.1	66.2	2.9	4.2	5.5	11.4	14.7	47.7
Crossbreed 3	M	909	85.6	61.2	3.4	4.4	5.7	13.4	12.9	45.1
	F	892	86.0	64.8	3.0	4.1	5.7	11.0	17.1	47.3
W. P. Rocks	M	914	86.5	63.2	3.5	4.7	5.6	12.7	13.8	44.9
	F	901	86.1	64.5	3.2	4.1	5.5	11.9	14.5	47.3
New Hamps.	M	911	85.9	62.8	3.5	4.6	5.6	11.8	12.8	45.0
	F	909	85.8	64.6	2.8	4.2	5.7	11.2	13.9	46.6
Cornish	M	917	88.0	68.4	3.4	4.3	5.2	10.6	15.4	48.8
	F	902	88.2	68.2	3.1	4.4	4.3	10.8	15.8	46.9
Av. all Breeds	M	911	86.8	64.3	3.4	4.6	5.6	11.9	13.6	46.2
	F	902	86.6	65.8	3.0	4.2	5.4	11.1	15.1	47.8

* Weights are averages obtained from 10 birds of each sex in each class.

** Eviscerated weight includes neck and giblets.

*** Total edible meat includes giblets but not neck meat.

TABLE 18.—Summary of 1952 experiment using broilers of 2.5 pounds live weight*

Breed	Sex	Live wt. (grams)	N.Y. d. as % live wt.	Evisc. wt.** as % live weight	Head as % live weight	Feet & shanks as % live wt.	Giblets as % live wt.	Viscera as % live wt.	Breast meat as % evisc. weight	Total edible meat*** as % evisc. weight
Crossbreed 1	M	1145	86.4	65.9	3.2	4.5	5.3	10.0	13.8	46.5
	F	1137	86.3	67.3	3.0	4.1	5.0	9.2	14.8	46.9
Crossbreed 2	M	1144	88.3	65.3	3.3	4.6	5.3	12.7	14.2	47.6
	F	1145	86.9	68.6	3.0	4.1	4.9	9.0	15.9	48.0
Crossbreed 3	M	1139	86.6	65.1	3.3	4.6	5.1	10.8	12.4	45.8
	F	1129	85.8	66.2	3.0	4.1	4.6	10.0	14.9	46.5
New Hamps.	M	1134	87.6	65.9	3.5	4.3	5.1	10.4	13.6	45.1
	F	1137	86.6	66.6	3.0	4.2	5.0	10.6	15.2	47.2
Cornish	M	1138	93.8	69.0	3.4	4.6	5.0	11.4	16.5	51.2
	F	1126	90.1	70.9	3.0	4.2	5.0	10.3	16.9	50.0
Average all Breeds	M	1140	88.5	66.2	3.3	4.5	5.2	11.0	14.1	47.3
	F	1135	87.1	67.9	3.0	4.1	4.9	9.8	15.6	47.8

* Weights are averages obtained from 10 birds of each sex in each class.

** Eviscerated weight includes neck and giblets.

*** Total edible meat includes giblets but not neck meat.

TABLE 19.—Summary of 1953-54 experiment with four crossbred broiler stocks. Weights are mean values of processing yields expressed as a per cent of live weight.

Breed	Sex	Live wt. (grams)*	New York dressed weight	Evisc. weight**	Head weight	Feet & shanks weight	Viscera weight	Giblet weight	Neck weight
W. Cornish Strain	M	1736	88.3	69.3	3.7	5.4	10.0	4.5	3.1
	F	1487	87.8	69.9	3.2	4.2	9.7	4.7	2.8
W. P. Rock x New Hamps.	M	1787	87.2	67.5	3.6	5.3	10.0	4.4	2.8
	F	1486	86.8	67.5	3.1	4.4	10.9	4.5	2.8
W. P. Rock x White Cornish	M	1688	88.3	68.0	3.6	5.3	10.7	4.7	3.1
	F	1468	87.0	68.4	3.3	4.3	10.2	4.7	2.8
W. P. Rock x (White Wyan. x W. Cornish)	M	1696	87.6	68.6	3.8	5.6	9.2	4.4	2.9
	F	1508	87.0	68.2	3.3	4.5	10.3	4.6	2.7
Average all Breeds	M	1728	87.8	68.3	3.6	5.4	10.0	4.5	3.0
	F	1486	87.2	68.5	3.2	4.3	10.3	4.6	2.8

* Live weight in grams average obtained from 25 to 30 birds per breed.
** Eviscerated weight includes neck and giblets.

TABLE 20.—Summary of 1953-54 experiment with four crossbred broiler stocks. Weights are mean values of raw carcass yields expressed as a per cent of total raw eviscerated weight*

Breed	Sex	Evisc** wt. (grams)	Breast meat weight	Other meat wt.	Bone*** weight	Total**** edible wt.
White Cornish Strain	M	1067	18.9	29.9	38.6	55.5
	F	991	21.5	29.9	35.0	59.4
W. P. Rock x N. Hamp.	M	1053	16.9	29.6	40.4	52.6
	F	978	19.1	29.5	38.5	54.5
W. P. Rock x W. Cornish	M	1041	18.0	29.6	38.3	54.9
	F	957	21.3	30.6	35.3	60.4
W. P. Rock x (W. Wyan. x W. Cornish)	M	1067	18.0	30.7	38.7	55.2
	F	1008	21.0	30.2	36.1	57.1
Average All Breeds	M	1057	18.0	30.0	38.9	54.6
	F	983	20.7	30.1	36.2	57.8

* Average obtained from 17 to 20 birds of each breed deboned raw.

** Eviscerated weight includes neck and giblets.

*** Does not include neck bone weight.

**** Includes giblet weight but does not include neck meat weight.

TABLE 21.—Summary of 1953-54 experiment with four crossbred broiler stocks. Weights are mean values of cooked carcass yields expressed as a per cent of total raw eviscerated weight*

Breed	Sex	Evisc. wt.** raw (grams)	Evisc. weight cooked**	Skin weight	Breast meat weight	Other meat wt.***	Neck weight whole	Neck meat weight	Neck bone weight	Giblet weight	Bone wt.****	Drip liq. wt.*****
White Cornish Strain	M	1525	75.3	7.7	14.2	25.7	3.4	1.6	1.7	4.2	16.9	33.6
	F	1096	76.5	8.0	15.9	23.8	2.8	1.2	1.5	4.3	17.1	36.0
W. P. Rock x New Hamp.	M	1479	79.1	8.4	13.4	24.5	3.3	1.2	2.0	3.9	21.2	36.3
	F	1085	76.9	7.9	14.8	23.7	3.3	1.1	2.0	4.6	19.6	39.2
W. P. Rock x White Cornish	M	1454	76.7	8.9	13.8	25.0	3.3	1.3	1.9	4.1	19.2	27.6
	F	1054	76.6	8.9	14.8	24.2	2.7	1.3	1.5	4.5	17.2	27.3
W. P. Rock x (W. Wyan.	M	1484	76.5	8.1	13.5	25.3	2.9	1.3	1.6	4.2	18.1	32.2
x W. Cornish)	F	1085	76.8	8.4	14.6	23.5	2.7	1.1	1.6	4.2	17.3	30.0
Average all Breeds	M	1486	76.8	8.7	13.7	25.1	3.2	1.4	1.8	4.1	18.8	32.5
	F	1080	76.2	8.3	15.0	24.1	2.8	1.2	1.7	4.4	18.0	33.4

* Average obtained from 8 to 10 carcasses in each class cooked 15 minutes at 15 pounds pressure in steam retorts.

** Eviscerated weights include neck and giblets.

*** Does not include neck meat weight.

**** Does not include neck bone weight.

***** Drip liquid weights are excessively high due to condensation of steam in the drip pans.

TABLE 22.—1953-54 experiment with four crossbred broiler stocks. Results of covariance analyses of processing losses and meat yields as affected by breed

Carcass weights	F values for males	F values for females
New York dressed weight[1]	2.47	0.05
Total eviscerated weight[1]	6.74**	8.49**
Head weight[1]	1.96	4.55**
Feet weight[1]	2.30	6.02**
Viscera weight[1]	7.85**	6.75**
Giblet weight[1]	20.11**	1.60
Neck weight[1]	3.68**	1.09
Breast meat weight[2]	7.16**	5.98**
Other meat weight[2]	1.77	2.17
Bone weight[2]	3.88*	19.76**

[1] Adjustments were made for differences in initial live weight.

[2] Adjustments were made for differences in initial eviscerated weight.

* Significant .05 level.

** Significant .01 level.

APPENDIX II

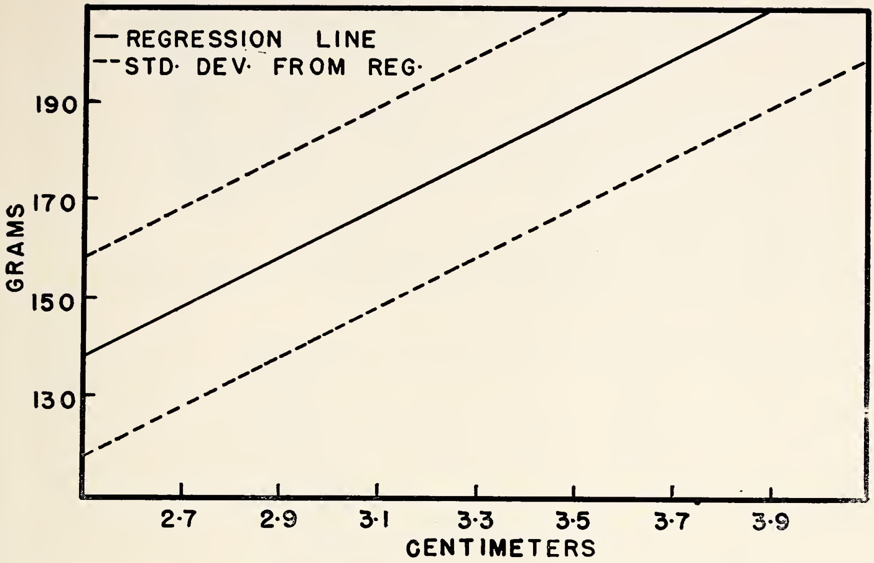


FIGURE 1.—Regression of breast yield on breast width for 12-week-old male broilers.

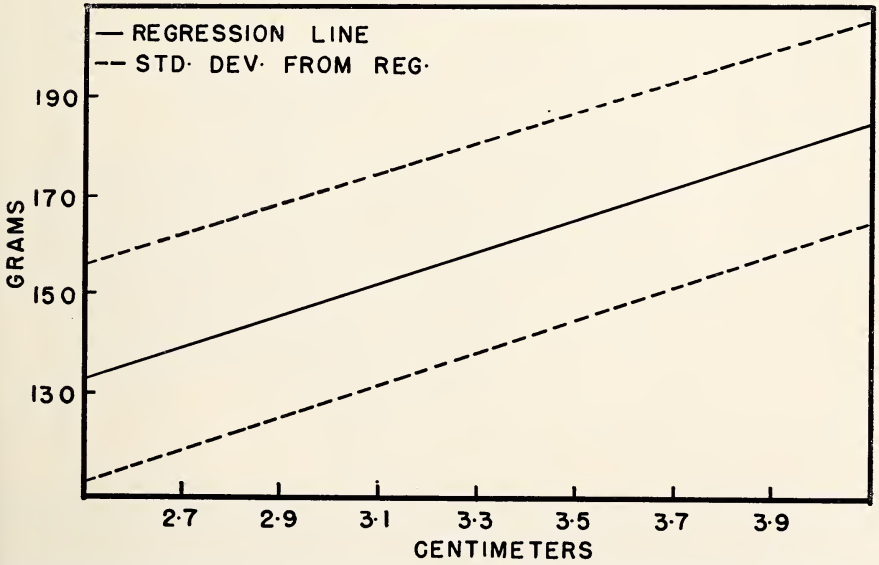
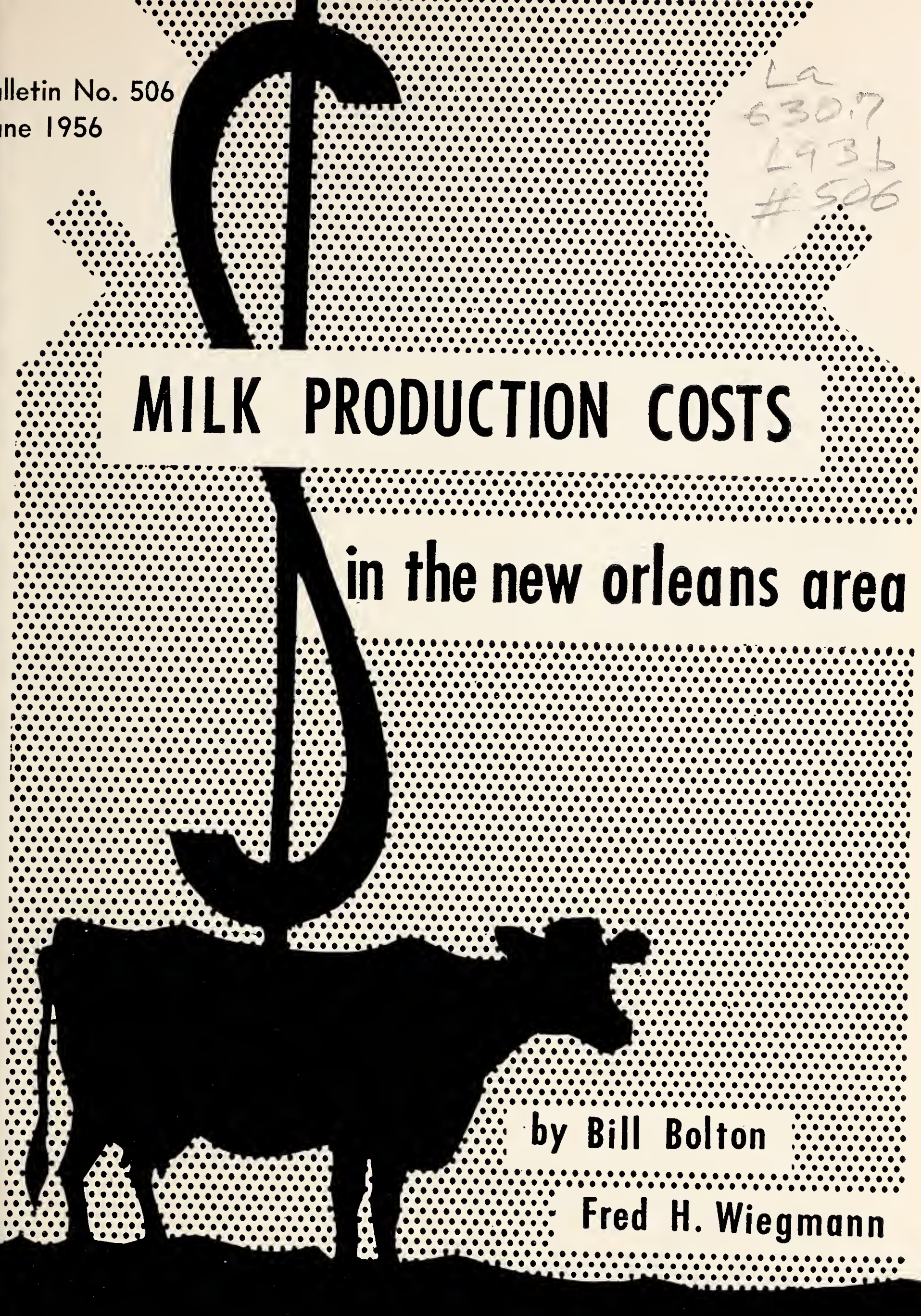


FIGURE 2.—Regression of breast yield on breast width for 12-week-old female broilers.

Bulletin No. 506
June 1956

La
630.7
L93b
#506



MILK PRODUCTION COSTS

in the new orleans area

by Bill Bolton
Fred H. Wiegmann

Agricultural Experiment Station
J. N. Efferson, Director
Louisiana State University and
Agricultural and Mechanical College

ACKNOWLEDGMENT

Numerous people and organizations contributed to this study in various ways. The authors wish to acknowledge and express appreciation for their combined interest and help.

Farm records were obtained by Messrs. E. W. Neasham, H. W. Anderson, E. A. Fulmer, R. C. Calloway, H. A. Toney, G. K. Alford, N. J. Matherne, B. S. Vance, D. H. Jones, and Sewell Bahm, all of the Agricultural Extension Service. Records were also taken by Messrs. Gene Dunham, J. L. Holcombe, Sam Gennaro, Lincoln Spencer, and the authors, all of the Department of Agricultural Economics. The cooperation of the Louisiana-Mississippi Milk Producers Association and the Kentwood Dairy Farmers Cooperative Association was obtained through Mr. Sam Smith and Mr. F. A. Yarborough, presidents respectively of the associations. Mr. H. C. Sanders, Director of Extension, Mr. Joe Richard, Assistant Director, and Mr. Carl Kemmerly, Assistant State Agent, all assisted in planning and coordinating the study. Necessary assistance of the New Orleans Milk Market Administrator's office was obtained through Mr. M. M. Truxillo, Administrator.

A special note of thanks is due the 125 dairy farmers who contributed their time and cooperation to the interviewers, thereby making this study possible.

We are grateful to Mr. Edward Stone, Department of Dairying, Mr. W. H. Alexander, Department of Agricultural Economics, and Mr. E. W. Neasham and Mr. H. W. Anderson, L. S. U. Extension Service, for reading and criticizing the manuscript.

TABLE OF CONTENTS

Page

INTRODUCTION 4

PROCEDURE 5

- Source of Data and Size of Sample 5
- Accounting Method 6

COSTS OF PRODUCTION 7

- Total Costs per Farm 7
- Average Costs per Hundred Pounds of Milk 7
- Average Costs Excluding Family Labor and Capital Charges 12
- Cash Costs 13

VARIATIONS IN COSTS 13

DIFFERENCES IN COSTS BETWEEN LOCATIONS 14

COSTS ON FARMS PRODUCING PRODUCTS OTHER THAN MILK 15

FEED PRODUCTION AND COSTS OF PRODUCING MILK 16

FACTORS CAUSING VARIATIONS IN COSTS 16

- Production Rates and Costs 16
  - Reasons for Differences in Production Rates 19
- Labor Efficiency and Costs 21
- Feeding Efficiency and Costs 22
- Combination of Factors Affecting Costs 24

SUMMARY AND CONCLUSIONS 26

Milk Production Costs in the New Orleans Area

BILL BOLTON AND FRED H. WIEGMANN

INTRODUCTION

Dairying represents an important part of the agricultural production of Louisiana. The well-being of this industry is important to both consumers and producers. While involving only 3 per cent of the number of farms in 1954, income from milk production amounted to 33 million dollars, or nearly 9 per cent of the agricultural income for the state.[1]

Recent years have brought technological changes to the dairy industry just as has been true in other agricultural production. Perhaps the greatest change has been the almost universal adoption of milking machines by commercial producers. Average milk production per cow has been slowly rising. Artificial insemination has been brought into the picture on a large scale to raise the average quality of dairy herds. Federal milk marketing orders have been introduced in some areas for the joint purpose of offering producers income security and incentives to provide a supply of milk in keeping with market needs.

All of these various changes have economic significance to the dairy industry. Generally, technological innovations bring about a need for better management. This is true in dairying as it is in other agricultural production. Technological changes may bring about either lower or higher costs. The speed and degree of adjustment to changes will vary with individuals and is often reflected in differences in producer costs.

Production costs and the factors and practices giving rise to them are of particular interest to farm operators. Information concerning average costs, their component parts, range, and relationships with various characteristics of the farm firm provide some criteria by which a manager may judge his own management relative to that of others.

This study is concerned with milk production costs and practices in the New Orleans milk marketing area. The objective of the study is to provide information on the costs of milk production and to relate various differences in costs to causal factors and economic principles. Such information will prove of value as a picture of the current cost structure for commercial dairying in the state, and will also suggest to farm managers areas in which adjustments may be made toward further improving efficiency of milk production.

Many of the principles and relationships developed in this report would be applicable to other areas of the state even though levels of technology and costs might not be the same as in the New Orleans Marketing Area.

---

[1] Farm Income Situation, U.S.D.A., A.M.S., September 1955.

PROCEDURE

Source of Data and Size of Sample

Approximately 2,750 farmers produced milk for the New Orleans Market during the year July 1953 to June 1954. About two-thirds of these producers were located in Louisiana and one-third in Mississippi. The distribution of the farms, by size of producing units, is shown in Table 1. For the purpose of this study a stratified random sample was selected from all of the farms in the marketing area. That is, the farms were divided by size into the groups shown in Table 1 and a pre-determined number of farms were selected at random from each farm size group. Sample farms drawn in each size group that were located in Mississippi or that had less than 50 pounds of production per day were excluded and other farms were selected at random to replace them.

Data on costs and organization for the period July 1953-June 1954 were collected from the sample farms through personal interview by representatives of the Louisiana Agricultural Experiment Station and the Agricultural Extension Service. Data on milk production were obtained from the market administrator's records. Approximately 125 records from individual farms were completed. Of this number, some were excluded from the analysis because they were incomplete, contained obvious misinformation, or involved unusual circumstances, such as the dairy business being of an incidental nature or not yet being fully established. This study is based on the records from 113 dairy farms, distributed as shown in Table 1.

TABLE 1.—Distribution of Producers and Production, by Size Groups, in the New Orleans Marketing Area, and Sample Distribution of Producers used in Study of Production Costs, July 1953-June 1954

Farm size group (production per day)	Per cent of producers in group	Per cent of total milk produced by group	Number of producers in study
Pounds of Milk	Per cent	Per cent	Number
Less than 100	9.0	2.7	2
100 - 200	35.8	20.2	23
200 - 300	26.5	24.5	15
300 - 400	12.9	16.5	16
400 - 500	6.6	11.0	16
500 - 600	3.7	7.4	12
600 - 700	2.2	5.3	12
700 - 800	1.1	3.2	6
800 - 900	.6	2.0	2
900 - 1000	.5	1.7	3
1000 - 1100	.4	1.7	0
1100 - 1200	.1	.6	0
1200 - 1300	.2	.8	2
1300 - 1400	.1	.4	2
1400 - 1500	.2	1.2	0
More than 1500	.1	.8	2

Accounting Method

Costs presented in this report were computed by net-cost accounting procedures. That is, instead of attempting to allocate individual cost items between the dairy enterprise and other enterprises, all farm costs were charged to the dairy business and all income from other enterprises was credited to the dairy enterprise. Stated differently, the costs of production for minor enterprises was assumed to equal their value. This procedure is considered to be valid in view of the fact that practically all farms were highly specialized dairy farms and other enterprises were incidental to the dairy business. The error attached to the "net-cost method," if any, should be very slight since the value of sales from other enterprises averaged only $300 per farm, $253 from crops and $47 from livestock and livestock products.

For the purpose of classification, costs were divided into four categories, which were: (1) labor, (2) purchased feed, (3) capital, and (4) other. Labor costs include actual cash outlays for hired labor plus unpaid family labor charged at the rate of 50 cents per hour. Feed[1] costs include only cash feed costs, and no additional charge was made for home-grown feed since the cost of producing home-grown feed is included in "other" farm costs. Capital costs include interest and depreciation.[2] Interest was charged at the rate of 5 per cent on average farm capital (the average of the beginning and ending inventory values). Items that depreciate were charged at original cost minus depreciation. Other items were charged on the basis of farmers' estimated value. Total depreciation cost was the difference between beginning and ending inventories. Depreciation was charged on the basis of estimated useful life as follows: tractors and water systems, 12 years; other machinery and equipment, 10 years; farm dwellings and milking barns, 20 years; dry barns and other structures, 15 years. "Other" costs included all costs not covered by the first three categories. Some of the major items included in other costs were capital additions and improvements, milk hauling, seed and fertilizer expense, machinery operating expense, veterinary and medicine costs, electricity expense and miscellanous dairy supplies such as cleaning materials.

In order to obtain a net cost to the dairy enterprise certain items were credited to the dairy enterprise and total credits were subtracted from the total of the four cost items. Credits included the value of farm products sold, other than milk, the sale of dairy animals, and the value of housing and produce furnished the family by the farm.

All computations and comparisons in this report are based on 4 per cent milk. The milk production of each farm was corrected to a 4 per cent basis in order to make the data from individual farms more comparable. The actual butterfat content of milk from the farms included in the study averaged 4.23 per cent.

---

[1] "Feed" in this report refers to grains, supplements and roughages.

[2] Since some farms had net capital appreciation instead of depreciation, average capital costs are lower than might be expected. However, this was reflected in higher "other" costs.

COSTS OF PRODUCTION

Total Costs per Farm

Total net cost per farm, and the various cost components, are shown in Table 2 for various sizes of producing units (measured by output of milk per day). The same information is presented graphically in Figure 1. The line curves show the tendency of the various average costs to increase as size of producing unit increases among the farms studied. The cost lines were fitted to the individual estimates from the 113 farms studied by the use of equations ($y = a + bx$).

TABLE 2—Total Production Costs per Farm, by Type of Cost and by Size of Producing Unit, on 113 Dairy Farms, New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Dollars per farm for					
	Purchased feed	Labor	Capital costs	Other costs	Credit	Net total costs
90	$ 679	$1,618	$1,296	$1,206	$1,305	$ 3,494
270	2,554	2,231	1,402	1,963	1,378	6,772
450	4,429	2,845	1,508	2,721	1,450	10,053
530	6,304	3,458	1,614	3,478	1,523	13,331
810	8,179	4,072	1,720	4,235	1,596	16,610
990	10,054	4,685	1,827	4,993	1,669	19,890
1170	11,929	5,299	1,933	5,750	1,741	23,170
1350	13,804	5,912	2,040	6,507	1,814	26,449
1530	15,680	6,525	2,146	7,265	1,886	29,730

While total costs and the separate items of cost increase with increasing size of farm, it can be seen that they do not necessarily increase in proportion to size increases, nor do the various cost components increase at the same rate. For example, when output doubles from 100 to 200 pounds per day, total costs do not double. Over the same increase in output purchased feed costs more than double, while capital costs increase very little. Among the four major cost categories, purchased feed costs tended to increase much more than labor and "other" costs with increases in output, while capital costs showed relatively little increase with increasing size.

Average Costs per Hundred Pounds of Milk

The data presented in Table 2 and Figure 1 are shown in Table 3 and Figure 2 on a cost per unit basis. The average total costs per hundred pounds at any given output is computed by dividing total costs at that output by total pounds of milk produced. The average total cost curve shows the costs per hundred pounds of milk that an individual producer

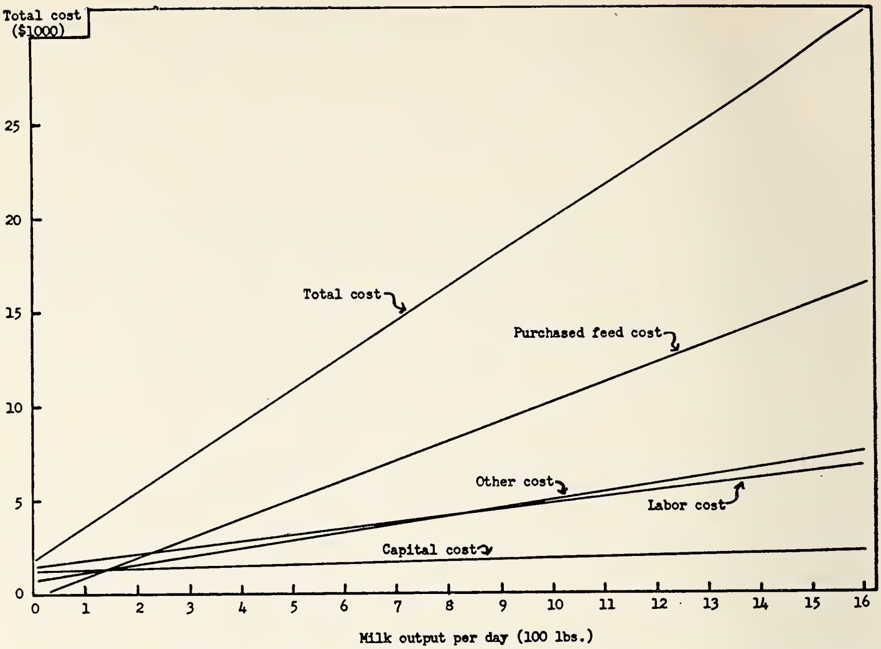


FIGURE 1.—Total Production Costs, by Size of Producing Unit and by Type of Cost, 113 Dairy Farms in the New Orleans Milk Marketing Area, July 1953-June 1954

could expect at any given volume of production when all costs (including non-cash or imputed costs) are included. It can be seen (Figure 2) that this average varies with the size of dairy. For example, average total cost would be about $6.00 per hundred at 500 pounds output per day and $5.50 at 900 pounds per day.

The average total cost curve shown is the total of the four individual cost component curves, minus credits. The shape that the total cost curve takes is an average of the shapes of the four component curves. While purchased feed costs increase slowly with increased output, the other three costs decline rapidly with increasing output before leveling off at a fairly high volume of production. Labor costs include both hired and unpaid family labor. Unpaid family labor makes up a very large proportion of total costs at low levels of production, as can be seen by comparing the average total cost curves with and without unpaid family labor in Figure 2. If labor costs were split into its two components, hired labor and unpaid family labor, the curve for unpaid labor would decline even more rapidly than the total labor cost curve shown. The hired labor curve would increase, since no hired labor was used up to about 250 pounds per day output.

Unpaid family labor and capital costs are two major cost items that exhibit fixed characteristics in this study and cause the average

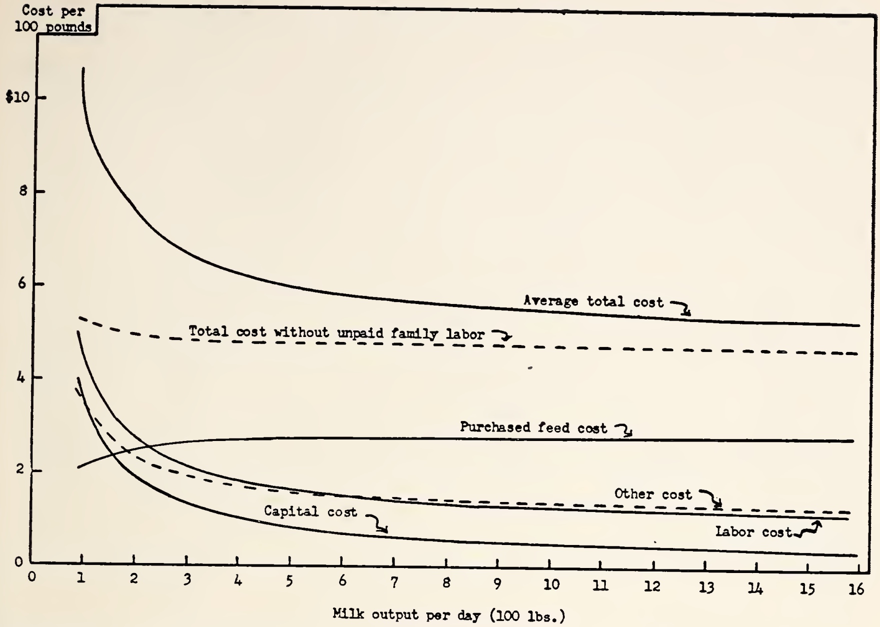


FIGURE 2.—Average Production Cost per Hundred Pounds of Milk, by Size of Producing Unit and Type of Cost, 113 Dairy Farms in the New Orleans Milk Marketing Area, July 1953-June 1954

TABLE 3.—Average Costs per Hundred Pounds of Milk, by Type of Cost and by Size of Producing Unit, on 113 Dairy Farms, New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Dollars per hundred pounds of milk for					
	Purchased feed	Labor	Capital costs	Other costs	Credit	Net average costs
90	$2.07	$4.93	$3.95	$3.67	$3.97	$10.65
180	2.46	2.93	2.05	2.41	2.04	7.81
270	2.59	2.26	1.42	1.99	1.40	6.87
360	2.66	1.93	1.11	1.78	1.08	6.40
450	2.70	1.73	.92	1.66	.88	6.13
540	2.72	1.59	.79	1.57	.75	5.92
630	2.74	1.51	.70	1.51	.66	5.80
720	2.76	1.43	.63	1.47	.59	5.70
810	2.77	1.37	.58	1.43	.54	5.61
900	2.78	1.33	.54	1.40	.50	5.55
990	2.79	1.30	.51	1.38	.46	5.52
1080	2.79	1.26	.48	1.36	.43	5.43
1170	2.79	1.24	.45	1.35	.41	5.42
1260	2.80	1.22	.43	1.33	.39	5.36
1350	2.80	1.20	.41	1.32	.37	5.36
1440	2.80	1.18	.40	1.31	.35	5.34
1530	2.81	1.17	.38	1.30	.34	5.32
1620	2.81	1.16	.37	1.29	.33	5.30

total costs to fall rapidly with increasing output. In other words, both these items appear to represent resources which are present on the farm and result in little, if any, more total cost at a large volume of production than at a small volume. Very little more unpaid family labor was reported being used on large farms than on small ones. Total investment also did not increase in proportion to increases in volume of production (Figure 3). Total investment per farm at average output of milk (284 pounds per day)[1] was about $21,000. At 600 pounds per day (slightly more than double the average output) total investment was about $29,000, a less than proportionate increase in investment as compared with milk output. Real estate and machinery and equipment investment in particular did not increase proportionately as size of farm (as measured by volume of production) increased, indicating that these resources were not fully used on the smaller farms. At the average output of milk an average of $12,500 was invested in real estate and $3,500 was invested in machinery and equipment. At an output of 600 pounds per day these investments in-

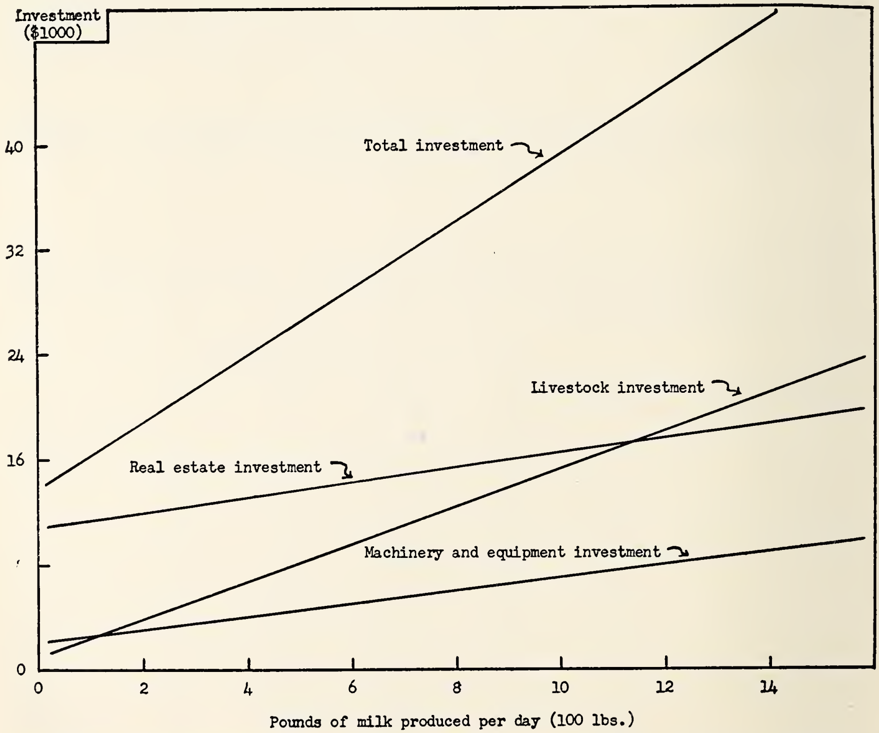


FIGURE 3.—Investment per Farm, by Type of Investment and Size of Producing Unit, 113 Farms in the New Orleans Marketing Area, July 1953-June 1954

creased to $14,000 and $4,500 for real estate and machinery, respectively. Investment in cattle tended to vary somewhat in proportion to changes in output, increasing from an average of $5,200 at 300 pounds output to $9,600 at 600 pounds output per day. These data indicate that, in comparison with large farms, the smaller farms were overinvested in the various items of capital and in labor. This fact is further illustrated by Table 4 which presents the composition of total costs and shows that labor and capital were relatively less important as cost items on large farms than on small farms.

---

[1] A weighted average of the output of all producers in the area; not the average output of only those farms studied.

Attention is called again to the fact that average costs of milk production were computed by attributing all farm costs and returns to the dairy enterprise. While this was valid from the standpoint of total costs per hundred, it may have caused certain cost components to be over- or under-emphasized. For example, some feed was produced on many farms. Where this was true the normal effect would be to decrease purchased feed costs and increase labor, capital, and other costs as compared to farms that produced no feed. In order to show feed and labor costs to the dairy enterprise, the value of home-grown feed was added to purchased feed costs and the value of labor that was not used directly for the dairy enterprise was subtracted from total labor costs. The results are shown in Table 5 and should be a fair estimate of the actual amount of feed and labor that would have been used directly by the dairy enterprise if no feed had been produced. The costs of labor and feed in Table 5 may be compared directly with similar data in Table 3 to see the effect of this change in cost allocation on the distribution of costs between components. Capital and other costs would have been reduced since less machinery, fertilizer and other materials would have been used.

TABLE 4.—Per Cent Composition of the Total Costs of Producing Milk, by Size of Producing Unit, 113 Farms in the New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Total cost[1]	Per cent of total costs comprised by				
		Purchased feed	Labor costs	Capital costs	Other costs	Cash costs
90	$14.62	14.2	33.7	27.0	25.1	39.3
180	9.85	25.0	29.8	20.7	24.5	49.4
270	8.26	31.4	27.3	17.2	24.1	56.7
360	7.48	35.6	25.8	14.8	23.8	63.3
450	7.01	38.5	24.7	13.1	23.7	68.0
900	6.05	46.0	22.0	8.9	23.1	79.2
1260	5.78	48.5	21.1	7.4	23.0	82.5
1620	5.63	49.9	20.6	6.6	22.9	85.5

[1] Before credits are subtracted.

If it could be said that there was an average cost of milk production for the area it would be the cost at the average output for all farms. The

TABLE 5.—Total Feed and Dairy Labor Costs per Hundred Pounds of Milk Produced, by Size of Producing Unit, 113 Dairy Farms in the New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Net total costs[1]	Total feed costs[2]		Dairy labor costs[3]	
		Amount	Per cent of total costs	Amount	Per cent of total costs
90	$10.65	$3.76	35.3	$2.66	25.0
180	7.81	3.49	44.7	1.86	23.8
270	6.87	3.39	49.3	1.60	23.3
360	6.40	3.35	52.3	1.47	23.0
450	6.13	3.32	54.2	1.39	22.7
900	5.56	3.26	58.6	1.23	22.1
1260	5.36	3.25	60.6	1.18	22.0
1620	5.30	3.24	61.1	1.15	21.7

[1] After credits are subtracted.

[2] Includes purchased and home-grown feed.

[3] Excludes farm labor not used by dairy enterprise.

average amount of milk produced per farm by all producers in the market was 284 pounds per day. The average cost of production at that point was $6.75 per hundred. On the surface such a cost seems high, as, in fact, do all costs along the entire average total cost curve. However, it should be recalled that this cost includes a charge for all the factors of production, including 50 cents an hour for unpaid family labor and 5 per cent return on all investment in the business.

Average Costs Excluding Family Labor and Capital Charges

It is true that in the long run the cost of all factors of production must be covered by the selling price or an individual producer would be financially better off by leaving farming and using his resources elsewhere. And for one who is considering going into the dairy business and who is going to buy and hire all his factors of production the total average cost curve would be of immediate interest. But to a producer already in production who owns his farm and has family labor available the costs of capital and unpaid family labor would be disregarded in making production decisions. Various other cost figures, particularly cash costs, would be of more interest to such producers and would greatly influence their decisions.

Total cost per hundred pounds of milk when unpaid family labor is not included as a cost is shown in Figure 2. It can be seen that this cost levels out at about $4.80 per hundred at an output of 300 pounds. There is much more reduction in costs at the low outputs when this item is removed than at the higher ones because about as much total unpaid family labor was reported on the small farms as on the large farms. The average cost of production excluding charges for both unpaid family labor and capital cost is $3.35 per hundred pounds of milk.

Cash Costs

Average cash costs (purchased feed, hired labor and other costs that involved a direct cash outlay) per hundred pounds of milk are shown in Table 6. These costs decrease until an output of about 300 pounds is reached and then increase slowly. However, these figures are not directly comparable with the net cost figures previously considered since credits have not been subtracted. The effect of removing credits from total cash costs is shown in the adjoining column. Cash costs minus credits per hundred pounds shows the costs (cash costs) that most producers would consider, less the returns (other than milk sales) that the farm furnishes. This helps to explain the presence of the large number of small producers at the same time that the total cost curve indicates that small producers are at an extreme disadvantage. The figures in Table 6 are likely the ones which exert the most influence on producer decisions.

TABLE 6.—Cash Costs of Producing Milk per Hundred Pounds, 113 Dairy Farms in the New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Cash costs per hundred pounds	Cash costs minus credits per hundred pounds
90	$5.74	1.77
180	4.87	2.83
270	4.69	3.29
360	4.73	3.65
450	4.76	3.88
900	4.80	4.30
1260	4.81	4.42
1620	4.82	4.49

VARIATIONS IN COSTS

Since there are variations in costs associated with size, a single average cost (such as $6.75 per hundred) obviously cannot be repreesntative of all size groups. Such a figure only represents an average for those farms that are at or near the average (284 pounds) production. But even at that point there are wide variations in costs among individual producers. That is, some have costs above the average and some have costs below the average. The percentage of farms of different sizes that had costs below the average ($6.75) is shown in Table 7. This table further indicates that a single average cost under-states total costs for most small producers and over-states them for most medium volume and large producers.

Since the average cost curve represents an average of costs at various levels of production, about half of the producers at any given output would be expected to have costs above the curve and about half would have costs below the curve. Actually the variation (range) in individual costs away from the average cost curve was quite large. Some of this

TABLE 7.—Per Cent Distribution of Dairy Farms having below Average Costs of Producing Milk, by Size of Producing Unit, New Orleans Producing Area, July 1953-June 1954

Pounds of milk produced per day	Per cent of farms having below average costs
Less than 200	11
200 - 400	39
400 - 600	76
600 - 800	94
800 - 1,000	75
1,000 or more	75

variation is chance variation associated with errors in enumeration, errors in estimating on the part of farmers, and various other causes. However, there were large differences in costs of production among individual producers because of differences in fixed costs structure, practices followed, production efficiency, and various other factors which could affect costs. The wide variation in costs among individual producers in the area is illustrated in Table 8. These data indicate the effect of size of producing unit on costs and also suggest some association between costs and production rates. These data also indicate that many of the producers could be considered efficient managers.

TABLE 8.—Frequency Distribution of Farms having Various Costs of Producing Milk, 113 Dairy Farms in the New Orleans Marketing Area, July 1953-June 1954

Costs per hundred	Number of farms	Average pounds of milk shipped per day	Average annual production per cow
Less than $4.00	12	626	6,012
$ 4.00 - 5.99	40	617	4,853
$ 6.00 - 7.99	30	489	4,399
$ 8.00 - 9.99	21	360	3,507
$10.00 or more	10	167	2,428

DIFFERENCES IN COSTS BETWEEN LOCATIONS

Eleven of the producers included in the study were located in and around New Orleans. Most of these farms were relatively large volume producers, and consequently weighted the large volume portion of the cost curve rather heavily. Since a large proportion of the high volume producers in the marketing area are located near the city of New Orleans, it is proper that they be included in the study of average costs for the area. At the same time, since there is reason to believe that production costs may be higher near metropolitan areas, it is interesting to compare costs of these producers with those of the other producers in the study. This comparison is presented in Figure 4.

Both average total costs and average variable costs (without the fixed costs of unpaid family labor and capital) are considerably higher for New Orleans producers than for the "country" producers. It is interesting also that fixed costs made up such a small proportion of total

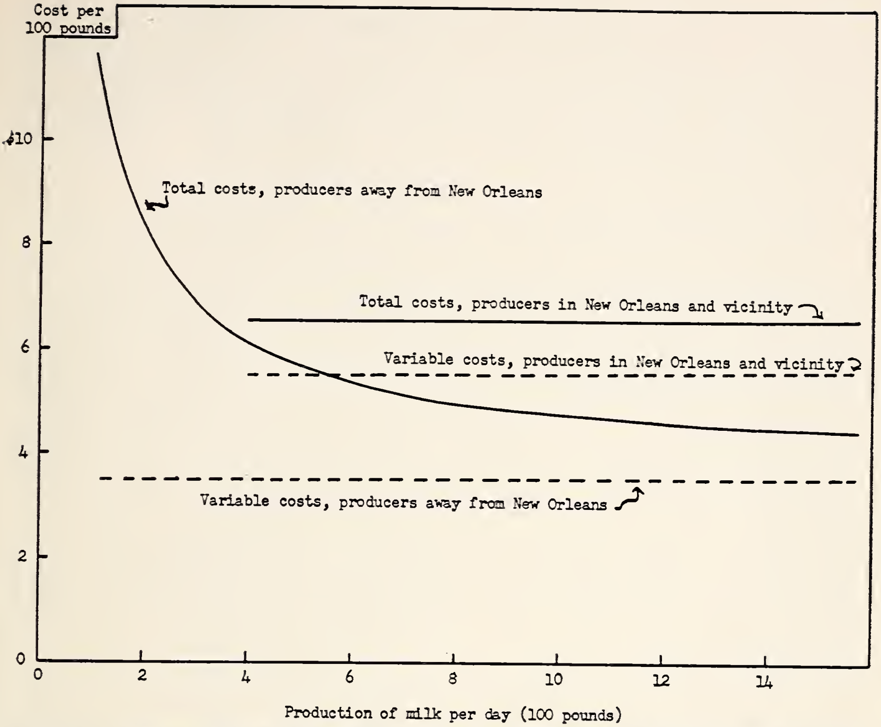


FIGURE 4.—Comparison of Production Costs between Milk Producers in New Orleans and Vicinity and Country Producers, July 1953-June 1954

costs for the New Orleans producers. Several of the city producers were operating fairly large dairies on very small tracts of land. This tended to reduce capital costs for that group but probably resulted in higher feed costs. Purchased feed costs were 30 per cent higher for the city producers than for the remainder of the farms in the study. Labor costs, because of competition from city jobs, were 50 per cent higher for the New Orleans farms than for those away from New Orleans. Differences in feed and labor costs accounted for most of the difference in costs between the two groups.

COSTS ON FARMS PRODUCING PRODUCTS OTHER THAN MILK

Among the farms studied, 16 sold crops, livestock, or livestock products other than dairy products, with a value of $500 or more. This group of farms had an average production of milk of 340 pounds daily. Average total cost for the group was $6.16 per hundred, essentially the same as average total cost for the entire group of farms at that level of production. At below the average output of milk production per day (284 pounds) costs tended to be higher on farms producing products other than milk, while the opposite was true for farms above average in size. It will be recalled that one of the assumptions involved in the accounting procedure used in this study was that the value of products other than milk about equaled their cost of production. The assumption would appear to be valid in view of the production costs on those farms that produced other products.

FEED PRODUCTION AND COSTS OF PRODUCING MILK

Eighty-three of the 113 farms analyzed reported the production of some feed in the form of grain, hay, or silage. Thirty reported that no feed was harvested, although most had pasture of varying quality. A comparison of milk production costs for the two groups of farms is presented in Table 9. While purchased feed costs are lower for the group of farms that produced feed, their total costs of production are higher than on farms that produced no feed, except at the very large size levels. All costs other than feed were consistently higher on the farms that reported feed production than on those that did not. Capital costs were higher as a result of more land, machinery, and equipment. "Other" costs were higher on farms producing feed, primarily because of fertilizer and seed costs. Credits were higher for the feed producing group, mainly because this group included most of the farms that had sales of products other than milk.

It cannot be inferred from the data shown that it does not pay to produce feed on dairy farms in the area. In fact, more than half of the 31 farms that had total production costs of $5.00 or less produced feed. It can be inferred, however, that many of the feed producers were not producing feed efficiently. It appears that a number of producers used additional machinery, equipment, labor, fertilizer, and seed to produce feed and then, for one reason or another, did not harvest enough feed product to pay for the additional costs. Less than half of the farms where home-grown feed was reported harvested feed valued at $1,000 or more.

FACTORS CAUSING VARIATIONS IN COSTS

It has been indicated that there was a great deal of variation in costs of producing milk among individual farms and that a large part of the variation was due to differences in size of producing units. The fact that farms of the same size had different costs also suggested that there were variations caused by factors other than size. In this section some of these other reasons for differences in costs will be considered.

Production Rates and Costs

The average amount of milk produced per cow on the farms studied was approximately 4,000 pounds annually. Production rates varied among individual farms from less than 2,000 pounds to almost 8,000 pounds of milk per cow. The effect of production rates on costs is shown

TABLE 9.—Costs per Hundred Pounds for Producing Milk on 83 Farms Producing Feed or Other Products and 30 Farms Producing no Feed or Other Products, by Size of Producing Unit and Type of Cost, New Orleans Producing Area, July 1953-June 1954

Pounds of milk produced per day	Total costs		Purchased feed costs		Labor costs		Capital costs		Other costs		Credits	
	No feed produced	Feed produced	No feed produced	Feed produced	No feed produced	Feed produced	No feed produced	Feed produced	No feed produced	Feed produced	No feed produced	Feed produced
100	$6.09	$10.93	$2.21	$2.47	$2.59	$4.91	$2.62	$3.75	$ .33	$3.78	$1.66	$3.98
200	5.77	7.93	2.76	2.50	1.85	2.92	1.43	1.96	.71	2.59	.98	2.04
300	5.65	6.92	2.93	2.51	1.60	2.26	1.03	1.36	.84	2.19	.75	1.40
400	5.62	6.42	3.03	2.51	1.48	1.93	.84	1.06	.91	1.99	.64	1.07
600	5.56	5.91	3.12	2.51	1.35	1.60	.64	.76	.97	1.79	.52	.75
900	5.53	5.58	3.19	2.52	1.27	1.38	.51	.56	1.01	1.66	.45	.54
1,200	5.50	5.42	3.21	2.52	1.23	1.27	.44	.46	1.03	1.60	.41	.43
1,500	5.50	5.32	3.23	2.52	1.21	1.20	.40	.40	1.05	1.56	.39	.36

in Figure 5. The lines showing above average and below average production each represents about half of the producers in the study. Production per cow averaged about 5,000 pounds for the above average group and about 3,000 pounds for the below average group. Seventeen producers had above 6,000 pounds per cow while 20 had less than 3,000 pounds per cow. At the average output for the area (284 pounds) farms with more than 6,000 pounds production per cow had average total costs (including unpaid labor and capital costs) of $5.10 per hundred pounds and those with less than 3,000 pounds production per cow had costs of $8.50 per hundred.

One of the major ways by which high production rates lower unit costs is by having more units of output over which to spread fixed costs. The costs of buildings and machinery would be no higher for cows producing 6,000 pounds than for those producing 3,000 pounds, but the costs per pound of milk would be lower. To the extent that high production rates represented inherent production capacity and not increased feeding or other variable inputs, variable costs per unit would also decrease with increased production rates.

Again, it should be pointed out that all costs shown, unless otherwise specified, are total costs per unit, including both fixed and variable

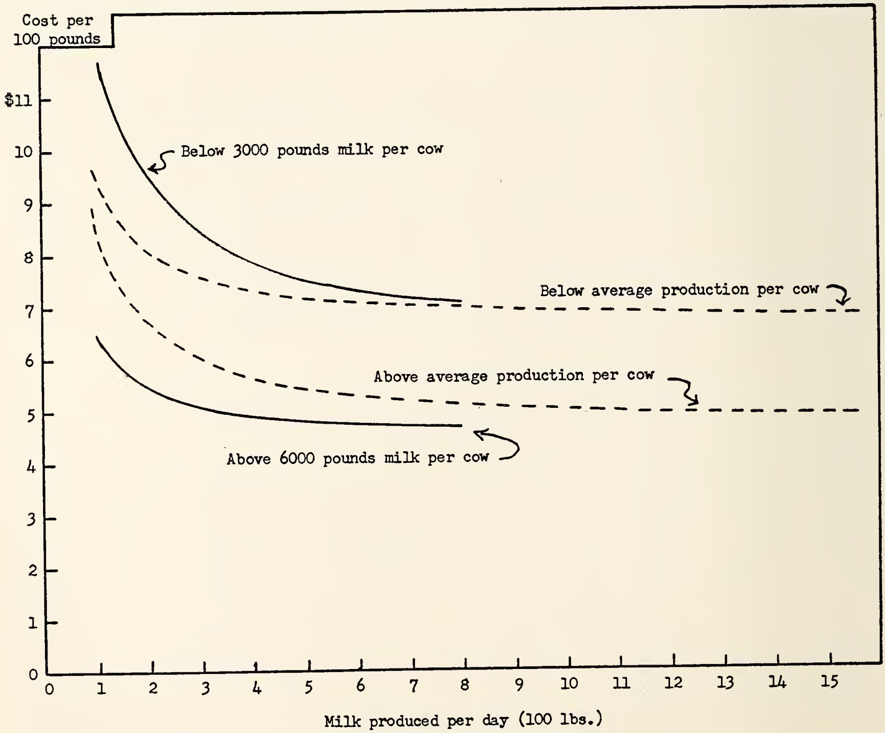


FIGURE 5.—Relationship between Production Rates per Cow and Cost of Producing Milk, New Orleans Milk Marketing Area, July 1953-June 1954

costs. The general discussion from preceding sections concerning the use of total average costs applies to all total average cost figures and comparisons in this publication. Again, these are not necessarily the costs which often exercise the greatest influence on decisions (see page 12).

Reasons for Differences in Production Rates—Differences in amount of milk produced per cow are probably caused by differences in inherent ability to produce and by differences in management practices, particularly feeding. An attempt was made in this study to measure quality of cows, or productive capacity, by farmers' estimated value of their animals. It is realized that this is a crude measure at best and subject to wide error among individual farms. However, the use of this measure indicates a positive relationship between quality of cows and milk production per cow (Table 10).

TABLE 10.—Relationship between Value of Cows and Milk Produced per Cow, 113 Dairy Farms in New Orleans Marketing Area, July 1953-June 1954

Value of cows	Number of farms	Pounds of milk produced per cow
$100 or less	14	3,553
$101 - 150	55	4,290
$151 - 200	32	4,739
More than $200	12	5,189

On a basis of five per cent interest and a productive life of four years for depreciation purposes, each additional $50 invested per cow resulted in $13.75 additional cost per cow. Since the $13.75 additional cost per cow resulted in 450 pounds of milk worth $25, this appears to have been a profitable investment.

Differences in milk production per cow associated with differences in feed cost per cow are shown in Table 11. On the basis of the data shown, the addition of feed up to about $150 per cow, as an average, appears to have been profitable. There is an indication that some producers may have been over-feeding for the amount of milk that was being produced.

Since quality of cows and feeding of cows are interrelated in their effects on milk production per cow, the combined effects of the two factors are shown in Table 12. The same data are graphed in Figure 6. These data indicate that the higher quality cows produced more milk

TABLE 11.—Relation between Feed Costs per Cow and Milk Produced per Cow, 113 Farms in the New Orleans Producing Area, July 1953-June 1954

Feed costs per cow	Number of farms	Milk produced per cow (pounds)
Less than $80	13	3,067
$ 80 - 104	15	3,698
105 - 129	18	4,190
130 - 154	25	4,583
155 - 179	19	4,671
180 - 204	8	4,634
204 - 229	7	5,414
230 or more	8	5,866

at the various levels of feeding and also responded more to increased feeding than did the lower quality cows. As a result, the most profitable level of feeding was higher for the better quality cows than for those of poorer quality. With more efficient management (including emphasis on kind and quality of feed) it is possible that all three groups would have had higher milk outputs at all levels of feeding. Based on the data shown, the most profitable level of feeding (where additional feed

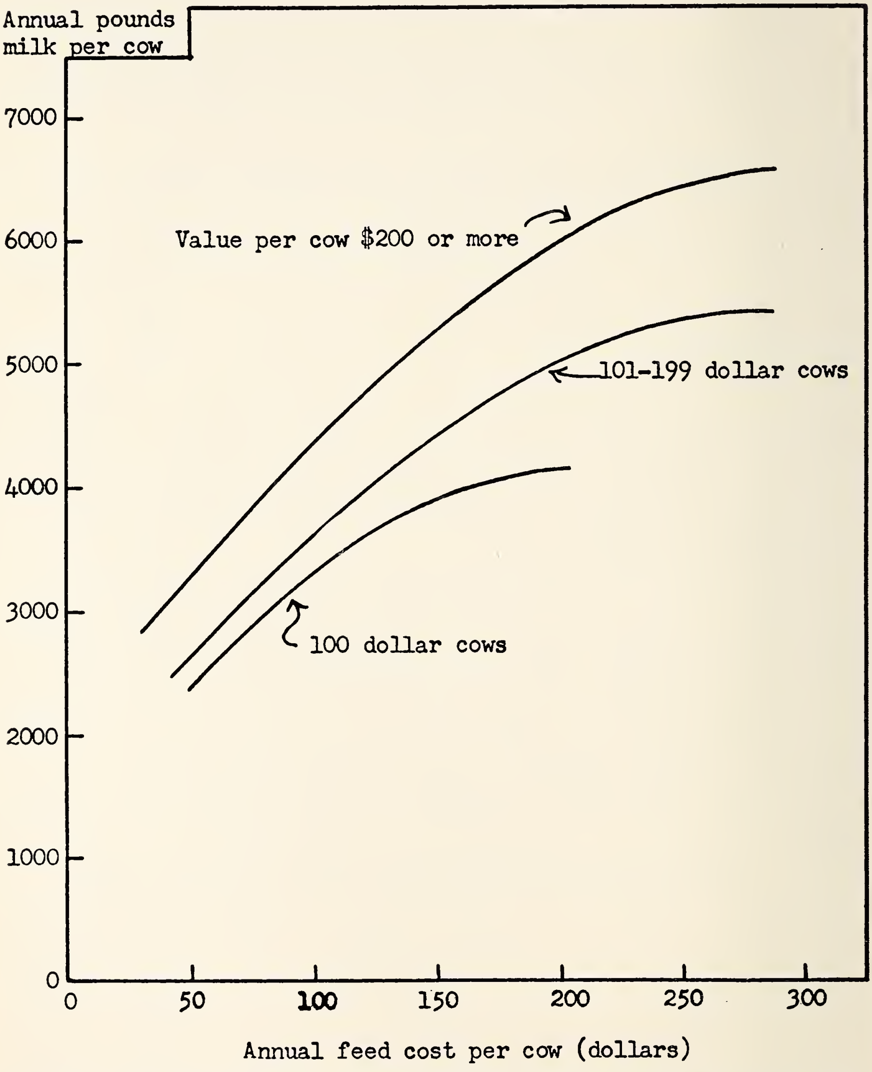


FIGURE 6.—Relationship between Value of Cows, Feed Cost per Cow and Milk Production per Cow, 113 Dairy Farms in the New Orleans Marketing Area, July 1953-June 1954

is just paid for by additional milk) would have been about $100 per cow for low value cows, about $140 per cow for medium value cows, and about $185 for high value cows.

TABLE 12.—Effect of Value of Cows and Feed Costs per Cow on Production of Milk per Cow, 113 Farms in the New Orleans Marketing Area, July 1953-June 1954

Feed costs per cow	Average pounds of milk produced by cows valued at		
	$100	$101-$199	$200 or more
Less than $80	2,451	2,781	4,279
$ 80 - 129	3,603	4,094	3,838
130 - 179	3,748	4,580	5,009
180 - 229	4,114	4,616	6,299
230 or more	....	5,421	6,608

Labor Efficiency and Costs

Since labor costs constitute a relatively large portion of total costs on dairy farms, it is to be expected that efficiency in the use of labor would have some effect on costs. Costs for those producers who were above and below average in the amount of labor used per cow are shown in Figure 7.

TABLE 13.—Relationship between Size of Producing Unit and Hours of Labor per Cow, 113 Dairy Farms in the New Orleans Marketing Area, July 1953-June 1954

Pounds of milk produced per day	Man hours per cow per year[1]
200	133
400	122
600	117
800	116
1,000	115
1,300	113

[1] Total number of hours devoted to dairy enterprise (excluding labor for crops, etc.) divided by number of cows in herd.

On the average size farm in the area there was an average of 128 hours per cow per year spent on dairy labor and associated tasks. According to USDA estimates the average labor requirement for dairying in Louisiana where milking machines are used is 118 hours per cow. For comparison, man hours per head in Iowa is estimated at 99, in Minnesota at 98, in Kansas at 100, in Arkansas at 114, and in Oklahoma at 107. These also are state averages and not measures of most efficient operation.[1] Less labor was used per cow on farms with large output of milk than on smaller farms (Table 13). The difference of 20 hours per cow between small and large farms would amount to a difference in costs

---

[1] Statistical Bulletin No. 161, *Labor Used for Livestock,* U. S. Department of Agriculture, A.R.S., May 1955. An earlier study in the Kentwood Area of Louisiana shows 153 hours per cow. See *An Economic Study of Dairy Farms in the Kentwood Area,* by J. Norman Efferson, La. Bulletin 325, June 1940, page 14.

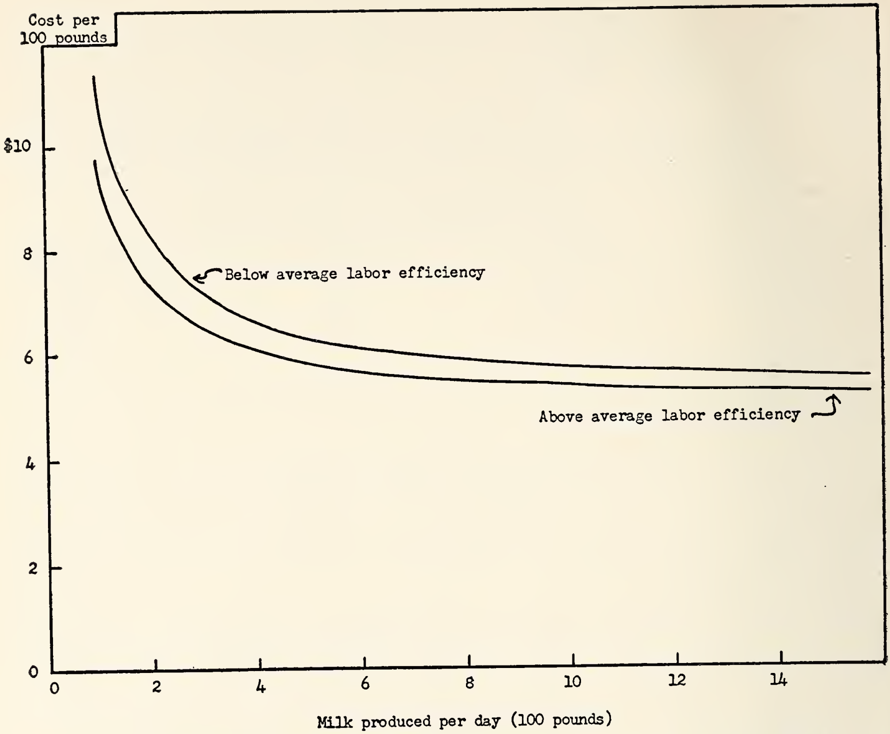


FIGURE 7.—Relationship between Labor Efficiency and Cost of Producing Milk, 113 Dairy Farms in the New Orleans Milk Marketing Area, July 1953-June 1954

of about 25 cents per hundred pounds of milk produced (at 4,000 pounds production per cow). While this is a 15 per cent reduction in hours, the differences in costs associated with labor efficiency are not so striking as those associated with production efficiency. A decrease in labor requirements of 60 hours per cow, which would about halve labor requirements and would be a remarkable decrease, would amount to 75 cents per hundred pounds decrease in costs. However, decreases in costs of even a few cents per hundred can be important in terms of total returns per year, particularly on farms with a fairly large volume of production.

Feeding Efficiency and Costs

To study feeding efficiency the farms in the study were divided into two groups having above and below average[1] feed costs per hundred

---

[1] The average value of feed used for the area was $135 per cow and $3.38 per hundred pounds of milk. Feed cost calculations were made on the basis of the entire herd (including calves and bulls) and were higher than if they had been determined on the basis of cows only. A.M.S. 6, *Rations Fed to Milk Cows, 1954* reported feed costs of $80 per cow and $2.79 per hundred pounds of milk with calculations based only on producing cows.

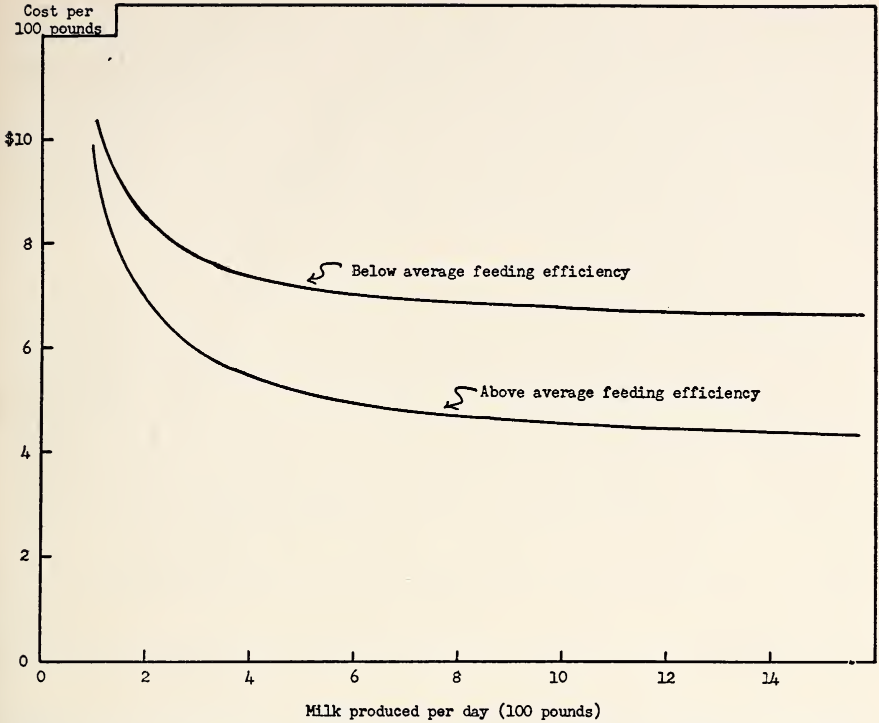


FIGURE 8.—Relationship between Feeding Efficiency and Costs of Producing Milk in the New Orleans Milk Marketing Area, July 1953-June 1954

pounds of milk. The production costs for these two groups are shown in Figure 8. However, feed costs per hundred pounds of milk has certain limitations as a measure of feeding efficiency, and these limitations must be taken into account in comparing costs between the two groups. The use of a figure (in this case the average feed cost of $3.40 per hundred pounds of milk) as a standard of efficiency would imply that those producers having below average costs were efficient feeders and those above average were not. This is not necessarily true. A producer could have a low feed cost per hundred pounds of milk because he was feeding very little (under-feeding). He might be a more efficient producer if he increased the amount of feed used (increased feed costs per hundred pounds of milk). Feed costs per hundred pounds of milk are also affected by the productive capacity of the cows that are being fed. Given the same amount of feed, a high producing cow will have lower feed costs per pound of milk than a low producing one. The farms with below average feed costs per hundred pounds had an average production per cow of about 800 pounds more than the higher cost farms. Therefore, a part of the difference in costs must be attributed to differences in production rates.

In spite of these limitations, the use of feed costs per hundred pounds of milk is probably valid as a gross measure of feeding efficiency. The difference in costs between the two groups is too large to have been accounted for by the difference in production rates alone. The shape of the two curves also indicates that a part of the difference is due to differences in feed used, in that increasing advantage is shown from feeding efficiency at the larger outputs. This would be expected since feed comprises a larger proportion of total costs per unit on large farms than on small farms.

Combination of Factors Affecting Costs

Several factors have been shown to have affected costs of production or caused variation in costs of producing milk among individual producers. While each of these factors has independent effects on production costs, they may also be interrelated. In the last section it was shown that production rates and feeding efficiency were not completely independent of one another in their effects on costs. Production rates and labor efficiency might also be related. A herd of 6,000-pound cows would pro-

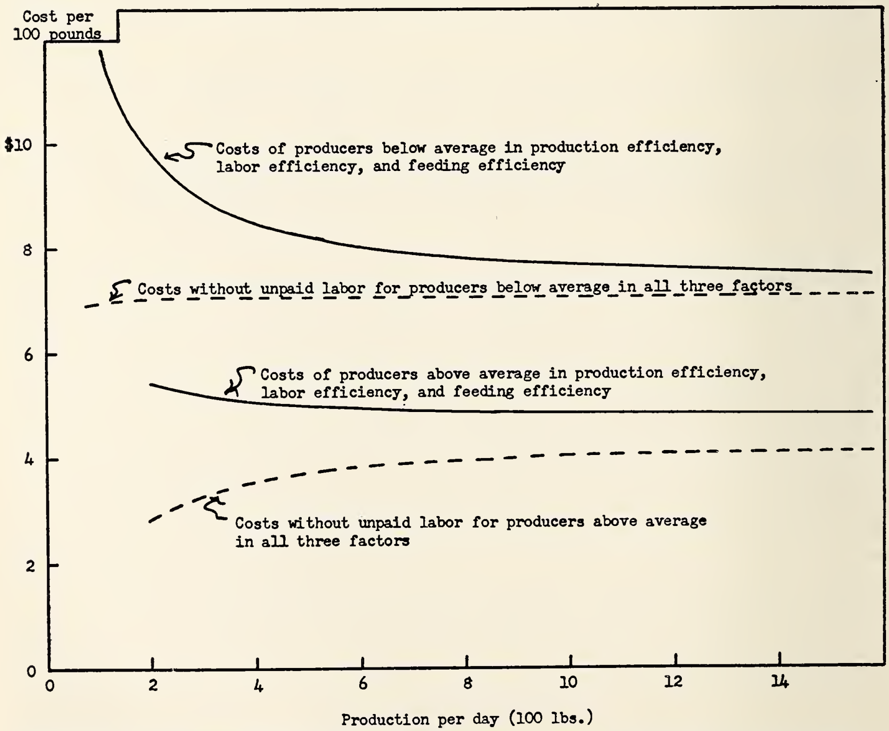


FIGURE 9.—Combined Effect of Selected Efficiency Factors on Milk Production Costs, Dairy Farms in the New Orleans Milk Marketing Area, July 1953-June 1954

duce twice as much milk as a herd of 3,000-pound cows yet twice as much labor would not be required for the higher producing herd. Size of business is interrelated with most other factors affecting costs. Good labor efficiency is difficult to obtain on a small farm. Good production and feeding efficiency might become more difficult to maintain as size of operation increases past some point, this point depending on the managerial ability of the individual producer.

Because of these interrelationships, an attempt has been made to show the combined effects, on costs, of the factors already discussed individually (Figure 9). There were 25 farms above average in terms of production efficiency, labor efficiency, and feeding efficiency, and 16 farms below average in terms of all three factors. These two groups by no means represent the ultimate in either efficiency or inefficiency. No farm actually excelled in all three of the factors measured. A farm could qualify for inclusion in the above average group simply by being slightly above average in all three. The same was true for the below average group.

The total cost curve shown in Figure 9, as with other total cost curves in this report, includes a return to all factors of production, including capital and unpaid labor. The broken lines beneath the average total cost curves show the production costs to these two groups when unpaid labor is not included as a cost. As indicated earlier, there is some evidence that most farmers do not include costs for unpaid family labor and most capital costs when making production decisions.

While it is evident that differences in size of business, production rates, feeding efficiency, and labor efficiency explain much of the variation in costs among farms, there probably are other factors that affected costs on individual farms. Capital costs, and consequently total costs, were affected by the efficiency with which capital items available on the farm were being used. Capital charges were made on some items, notably land and machinery, that were being used very little on some of the farms in this study. It is probable that the level of management, and therefore costs, varied considerably with the goals or aims of individual operators. Some operators, for example, had off-farm sources of income and expected the farm to yield little more than a cheap place to live. In short, the factors that could cause an individual producer to have high or low costs as compared with other producers are both numerous and difficult to measure, particularly where they may include the operator's desire to partially substitute other goals for maximum income from the farm.

SUMMARY AND CONCLUSIONS

The "average" cost of producing milk for the New Orleans Marketing Area during the period July 1953-June 1954 was approximately $6.75 per hundred pounds. This was slightly above the average Class I price of $6.50 for the year and considerably above the average blend price of $5.56. This average cost was the cost at the average output per farm of 284 pounds of milk per day and included a charge of 50 cents an hour for unpaid family labor, and interest and depreciation charges for all farm capital. In other words, "average" costs included a return to all factors of production. It was composed of two parts: (1) variable costs, for which actual direct or indirect outlays of cash were reported by farmers; and (2) fixed costs, which involved no cash outlay but for which charges were imputed (primarily unpaid family labor and capital costs). There is reason to believe that charges made for fixed costs may have been too high, because (1) there is a normal tendency for farmers to over-estimate the amount of unpaid family labor used and (2) much capital (particularly in the form of land) for which full charges were made was being grossly under-used. There is also reason to believe that most farmers often do not include a considerable portion of these fixed costs in making decisions. Otherwise, it is difficult to explain the presence of such large numbers of small producers, whose fixed costs are high. The average cost of production for the area without these charges was approximately $3.35 per hundred pounds of milk.

There is nothing remarkable or novel about costs of production approximating selling price. In fact, it is inevitable that this will occur if a proper charge is made for all factors of production. Simple economic principles tell us that if the price of a commodity rises the cost of the factors of production (land, labor, etc.) suitable for its production will be bid up and less efficient producers will be attracted into production with the result that average costs will rise. Conversely, and in the same manner, a decline in "the average cost of production" would be expected to follow a fall in price. Therefore, average total costs of production for an industry would seldom be found to differ much from the selling price of the commodity except during relatively brief periods following major changes in price or technology.

The foregoing does not mean that individual dairy producers cannot make a profit above all costs. It does mean that the "average" producer cannot expect much return above a wage for his labor and interest on the capital he has invested. The value of a cost of production study to an individual producer comes, not through showing the average costs, but rather through showing the variations that exist in costs among individual producers together with the causes of these variations, thereby suggesting ways to lower costs.

It has been indicated that differences in size, production efficiency, labor efficiency, and feeding efficiency explained much of the cost variation among individual dairy farmers. In general, increases in size, other factors remaining equal, lower costs by spreading fixed costs over more units of production. In general, increases in efficiency in the other factors result in reducing variable costs per unit. For example, an individual might find himself at point A in Figure 10 (which could correspond to the average position of producers in this study). He could reduce his cost per unit simply by increasing output from A to B. This could be done by adding more cows of the same quality that he already owns and following the same practices as before. This movement would not only give a larger margin between the cost of each unit and selling price but would also give more units to sell. All of the reduction in costs would be through lower per unit fixed costs, with variable costs per unit unaffected or perhaps even increased slightly.

It might also be possible for the same producer to move from a cost of A to C while keeping his output constant. In this case the reduction would be through reduced variable costs per unit with per unit fixed costs unaffected. Such a change in cost could occur because of more efficient feeding (lower feed costs per 100 pounds of milk), or more efficient use of labor (especially where hired labor is used), or through the use of higher producing cows (fewer cows producing the same amount of milk).

It would also be possible for an operator to move from A to D. In this case both fixed costs and variable costs are reduced. Such a movement could take place as a result of a conscious effort to increase output and a corresponding effort to reduce feed and labor costs. Or it could take place as a result of the interrelationships that exist between the various factors. Replacing a herd of low producing cows with the same

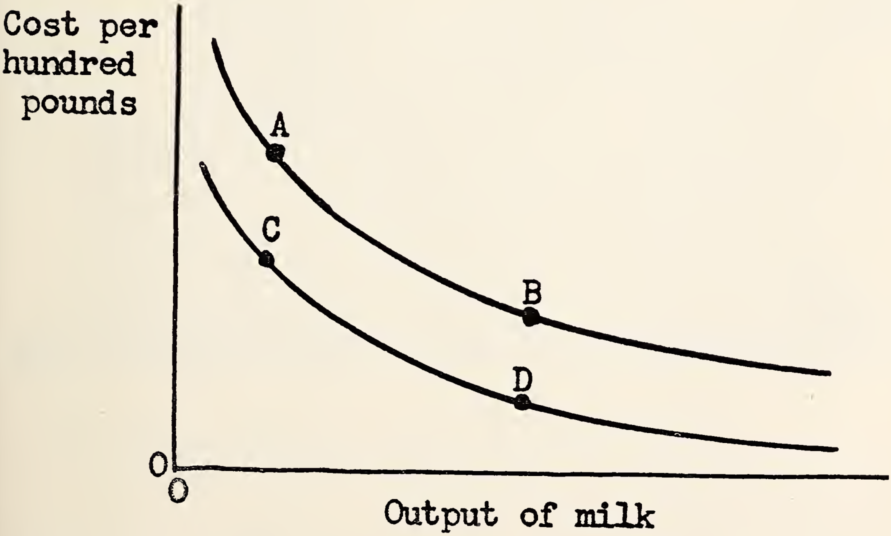


FIGURE 10.—Graphic Illustration of Alternative Means of Lowering Costs for an Individual Producer

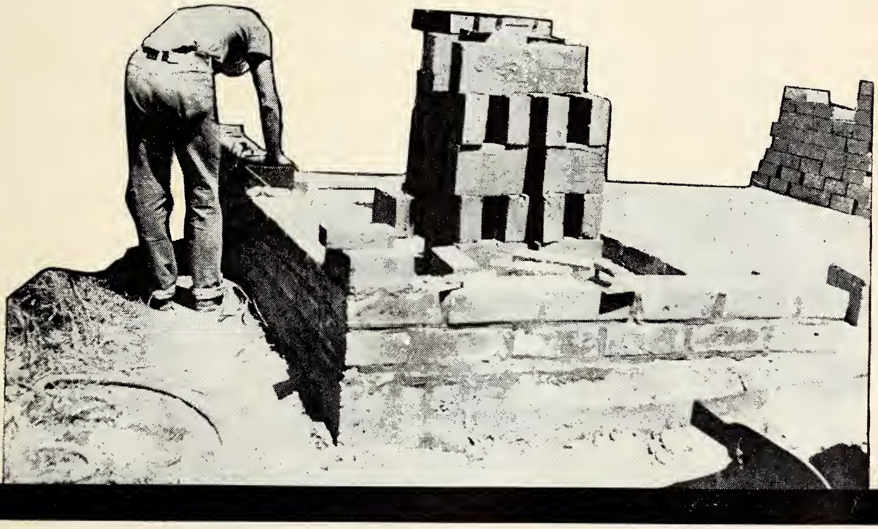
number of high producing cows could accomplish this by increasing the volume of milk produced and at the same time, since the same number of cows as before are involved, reducing feed and labor requirements per hundred pounds of milk.

The data from the farms studied indicate that at least some of these possible methods for reducing costs could be used on most of the farms in the area. Indications of excess capacity in terms of investment in buildings, land, and machinery, particularly on the smaller farms, indicate that on many farms size of operation could be increased with the cost of cows being the only additional investment required. The fact that average production was low and that there was a definite relationship between milk production and cow quality indicates that size could also be increased by a relatively small investment in better cows. The latter method of increasing size would tend also to lower feed costs per unit of output. Either method of increasing volume would tend to lower labor requirements per unit of output. The data indicated that many farms were over-feeding for the amount of milk produced. On such farms more careful attention to feeding cows according to productivity would result in appreciable savings in feed costs per unit of output. Similarly, some producers were under-feeding cows with a higher potential production than was being obtained. Increased feeding on these farms would have profitably increased production per cow. The average labor use of 128 hours per cow indicates that labor costs could be reduced, independent of size considerations, through improved job planning and work methods.

Bulletin No. 507

June 1956

POSSIBLE USES FOR WASTE RICE HULLS in Building Materials and Other Products



by JOHN H. HOUGH and HAROLD T. BARR

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University
and
Agricultural and Mechanical College

Possible Uses for Waste Rice Hulls In Building Materials and Other Products

JOHN H. HOUGH AND HAROLD T. BARR

INTRODUCTION

Utilization of agricultural wastes has long been a matter of primary concern to all those connected with agricultural agencies. Large amounts of money and much effort are expended in research each year by various agricultural agencies. Much has been accomplished; more remains to be done. Our steadily increasing population and the resultant drain on our natural resources make it more and more imperative that no stone be left unturned in the search for potential uses for the vast amount of agricultural wastes now existent in the United States.

One of the largest agricultural wastes in Louisiana is rice hulls. Each year some 144,000 tons of rice hulls remain after the rice is processed for consumption. A small amount of these hulls is put to use but the bulk remains as an unusable waste which has to be disposed of by burning and dumping the ashes or by dumping the hulls and then burning. This is not only a waste of potential material but also a waste of dollars since disposal of the hulls is quite expensive. In an effort to discover new uses for the waste rice hulls the authors have investigated some possibilities which may, to a small extent at least, help alleviate this situation.

AVAILABILITY AND COMPOSITION OF RICE HULLS AND ASH

The main rice producing areas of the United States are concentrated in five states—Arkansas, California, Louisiana, Mississippi and Texas. As there are many possible uses of rice hulls and ashes, the supply and composition are given in the following table, listing 1954 figures, the latest available.

	Rice	Rice Hulls	Ash
Arkansas	744,440 tons	126,555 tons	25,311 tons
California	529,495 tons	90,014 tons	18,003 tons
Louisiana	719,432 tons	122,303 tons	24,460 tons
Mississippi	142,547 tons	24,233 tons	4,847 tons
Texas	806,582 tons	137,119 tons	27,424 tons
TOTAL	2,942,496 tons	500,224 tons	100,045 tons

ACKNOWLEDGEMENTS—The authors would like to express their gratitude to Mr. J. P. Gaines, Assistant to the President, The Rice Millers' Association, and to its member mills for the wonderful cooperation received throughout the entire project.

Approximate Analysis of Rice Hulls
(All varieties)

Moisture	8.49%	to	11.00%
Ash	15.68%	to	18.59%
Ash (Insoluble in 10% HBI)	14.50%	to	17.52%
Crude protein	2.94%	to	3.62%
Ether soluble extract	0.82%	to	1.20%
Crude fiber	39.05%	to	42.90%
Nitrogen free extract	24.70%	to	29.38%

Typical Chemical Analysis of Rice Hull Ash

Silica (SiO_2)	94.50%
Calcium oxide (CaO)	0.25%
Magnesium oxide (MgO)	0.23%
Potassium oxide (K_2O)	1.10%
Sodium oxide (Na_2O)	0.78%
Phosphoric oxide (P_2O_3)	0.53%
Sulphates (SO_3)	1.13%
Aluminum, manganese, ferric oxides (Al, Fe, Mn)	Traces

USE OF RICE HULLS

Over the years many attempts have been made both in this country and other countries to utilize rice hulls. To date the results have been partially successful. However, with changing conditions, new techniques and more intensive research, it is highly possible that uses for this waste product may yet be found that will turn a present liability into a future asset. It has been impossible to obtain any accurate figures on what percentage of the available hulls are at present being economically utilized, but it seems safe to assume that it is less than 25 per cent.

Of the known potential uses, both past and present, the most significant are the following.

Use as a Fuel

Several rice mills use the hulls as fuel in the steam boiler furnaces. In some cases, even though all of the hulls are not needed as fuel, they are fed into the furnace in order to facilitate disposal. The fuel value of rice hulls is quite low, averaging 5,500 B.T.U. per pound, and the high ash content (20 per cent) of the rice hulls causes some difficulty. The hulls are generally fed into the furnace by a screw conveyor. Falling into the furnace, the hulls are met with a jet of steam and blown towards a small target. Under these conditions the hulls burn in the air and the ash and carbonized hulls fall to the bed of the furnace. To prevent the ash from piling up, a stream of water is made to flow over the furnace bed and the ash and carbonized hulls are continuously washed into a sump pit.

From the pit the ash is pumped to wagons or ditches for disposal. The wagons are so made that they retain the ash but allow most of the water to drain back into the sump pit before proceeding to the dumping grounds. It is important that the amount of air entering the furnace be controlled so as to prevent ash and carbonaceous material being blown from the stack. Particles of such material have been known to cause eye injuries. At some mills the hulls are hauled away and dumped on waste land where they are burned. Hauling charges are as high as $2.50 per ton. Because of the increasing shortage of dumping grounds and the smoke nuisance caused by open air burning, this method may have to be abandoned.

Use in Fertilizers

One fairly large use for rice hulls is as a component in mixed fertilizers. The hulls prevent caking of the fertilizer salts and also tend to lighten the soil by the addition of organic matter. They add practically no nitrogen, potassium or phosphorus to the fertilizer.

Use as a Supporting Medium in Hydroponic Tanks

Rice hulls have been used as a supporting medium for growing vegetables hydroponically. In the natural state they tend to cake more than other materials used. It is claimed that when heated to a point where they become brittle, coarsely ground and treated with a synthetic detergent, they are satisfactory for this use.

Use as a Feed

Ground hulls are used to some extent as a filler in mixed feed. They are quite low in food value and in some states were outlawed in the belief that the sharp roughened edges of the ground hulls were injurious to the digestive tracts of animals. Late reports indicate that this belief is erroneous and that several states where their use was banned now allow a certain percentage of ground hulls to be added to the feed.

Use as Insulating Material

For years rice hulls have been used as a loose insulant in dwellings, farm structures and cold storage plants. If desired they can be flameproofed by soaking in a solution of boric acid and borax. (See appendix for details of method used.) Tests indicate that the insulating value of rice hulls is quite high and compares favorably with rock or glass wool. However, the loose fill tends to settle and will harbor vermin. Where extreme temperature differentials are to be expected, vapor barriers must be used to prevent vapor condensation within the hulls.

One very interesting use of rice hulls is to insulate steel ingots from too rapid cooling. One report* states as follows:

"In the pouring of steel ingots into an ingot mold, the outside of the mass of metal cools at a fairly rapid rate and loses its plasticity, whereas the center or core of the mass of metal cools much more slowly and because of its retained plasticity takes up most of the shrinkage. This shrinkage makes itself evident in the form of an inverted cone which reaches down many inches into the heart of the ingot.

"All of the slag forming elements that are present when the steel is poured rise to the top of the mold and are present in abundance throughout the funnel. This makes it necessary to cut off and discard the entire section in which the funnel is located. It was found that rice hulls placed on top of the poured ingot, burned, forming a light fluffy ash which is an almost perfect insulator for this purpose. The insulation caused the entire upper section of the ingot to remain plastic for a greater length of time, causing the shrinkage to be more evenly distributed and thereby reducing the depth of the funnel."

---

*L. C. Rose, Colorado Fuel & Iron Corp., Pueblo, Colorado, in Northern Regional Research Laboratory release.

The above suggests that rice hull ashes might be used for an insulant in walls and ceilings of buildings. The ash is fireproof and would have no attraction for rodents or vermin.

Use as a Filler in Plastics and Refractory Materials

Some attempt has been made to use finely ground rice hulls as a filler in plastics. Although successful, it was found that the highly abrasive qualities of the hulls caused excessive wear on the metal parts of the equipment used. At least two companies in the U. S. are currently experimenting with the use of rice hull ashes as a filler in plastics.

Rice hulls can be used as an organic filler in refractory bricks where the organic matter is burned out during the firing to produce a lightweight porous product. At least one major company in the U.S. is conducting tests to determine if rice hulls can be used in lieu of the cork granules now being used to produce the refractory brick. Of interest is a letter received from Mr. H. Reiser, of Lake Charles, La. In part, the letter states:

"We are writing you of some of our experiences with burned rice hulls. After experimenting for a while, our Mr. Reiser secured a patent No. 1945232, dated January 30th, 1934. We have and still are using burnt rice hulls in a clay mixture used for grey iron cupola lining, for the ladle linings, for cores for both iron and brass castings and for lining for the brass furnace, and find that the linings can be much thinner than any substance we have used before. They also last longer.

"The Louisiana State Rice Milling Company is using our fire clay in their furnaces. We have samples taken after use in an acid sludge furnace of the Gulf Oil Refinery. Also, a sample taken from the furnace of a steam locomotive of the Kansas City Southern after one year of service. And we also have a report after use in ocean going steamship boilers." This letter suggests the need for more research on the feasibility of such uses for rice hull ash.

The Ontario Research Foundation in Toronto, Canada, reports successful research conducted under the direction of Mr. James D. Jones on the use of rice hull ashes in the making of refractory bricks and porous media. It is reported that at least one company in Canada is manufacturing porous plates patterned after the results obtained by this Foundaiton and selling them to a U.S. company for use in hot air furnaces as part of the humidifying system.

During the last 30 years several individuals have successfully developed methods of extracting activated charcoal from rice hulls. As far as is known, no commercial processes are being operated as a result of this work. It is reported that the charcoal is very fine and exceedingly difficult to handle.

Use in Manufacture of Furfural

Rice hulls have proved very satisfactory as a raw material for the manufacture of furfural. Some 15,000 tons are used yearly for this purpose, and it would appear that much more may be used in the future. Furfural is used as a selective solvent in purifying wood rosin, petroleum lubricating oil, diesel engine oils, vegetable oils, and as a raw material in the manufacture of nylon.

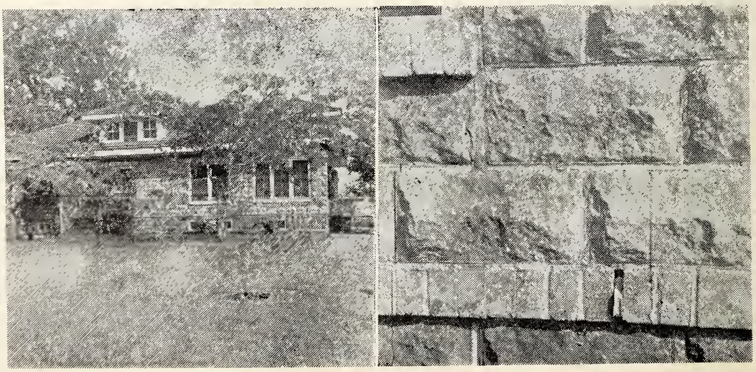
Use as an Industrial Cleaning Agent

The abrasive character, which has been a handicap in some of the suggested uses for rice hulls, could be well capitalized on by using the hulls as an industrial cleaning agent. For years, ground corncob particles have been used as soft blast cleaning materials. With proper air pressure, dirt and carbon can be cleaned from engine pistons, cylinders and other parts quickly and safely without removing any of the metal. It has been found that a mixture of 60 parts corncob grits and 40 parts unground rice hulls work better than the corncobs alone. The use of this mixture could well be extended to the cleaning and polishing of iron, steel, aluminum, brass and bronze parts and the cleaning of electrical equipment.

Use of Rice Hulls and Rice Hull Ash in Lightweight Concrete Blocks

Several attempts have been made to use rice hulls and rice hull ash as an aggregate in lightweight concrete. In 1923, Mr. Louis Privat, of Rayne, Louisiana, successfully manufactured building blocks from cement and burned rice hulls. A large house was constructed from these blocks and today (1956) it is in excellent condition. Unfortunately, no records were kept of the proportions of cement and hulls used.

One Texas mill has successfully used rice hull ash for making concrete blocks under the trade name "Ricement." It is reported that



Left: Cement-Rice Hull Block House Built in 1923 at Rayne, La. Right: Close-up of Blocks Used in House.

the blocks weigh 40 pounds per cubic foot and that they can be sawed or nailed. Several buildings were constructed from these blocks, but manufacture was finally discontinued. A letter received from Mr. R. H. Hancock, owner of the patent, states in part: "We soon found out it was not practical, due to the limited amount of burnt rice hulls available." Both makers of the blocks stated that it was necessary to coat them with a waterproofing medium so they were not exposed to the weather.

The Bruning Construction Company of Crowley, Louisiana, has constructed some houses using a cement-rice hull panel in a metal frame. Although these panels met all requirements for strength, they proved more costly than first estimated and apparently their use has been discontinued.

The Tata Memorial Hospital in Bombay, India, utilized a cement-rice hull concrete for partition walls and floors. A report received from the Sir Dorab Tata Trust, which maintains the Memorial Hospital, states in part: "Feathercrete (cement rice hull concrete) was largely used in the floors and partitions. It expands and contracts considerably, producing large cracks. It has no weight carrying capacity. Its compression and tensile strengths are weak. It has poor resistance to weathering and to impact. It has good insulating value."

In California tests were made on a cement-rice hull concrete (Hullcrete), but the process was discarded because the cost was too high for those mixes that gave sufficient strength for general building purposes.

RESEARCH WORK AT L.S.U.

Several years ago the Agricultural Engineering Research Department of the L.S.U. Agricultural Experiment Station started an investigation into the possibilities of using waste agricultural products as possible building materials. Research on the feasibility of a cement-rice hull concrete was considered first.* Many tests were made over a three-year period, and the results, though by no means conclusive, do indicate, in a broad sense, the potential value, both positive and negative, of utilizing rice hulls as an aggregate for a lightweight concrete.

A second phase of the use of rice hulls and ashes was in the making and testing of adobe brick from the various Louisiana soils.

Purpose and Scope of Work

The objective was to produce a concrete, utilizing rice hulls, which could be used in block or monolithic form; to determine the characteristics of this concrete and to perfect a method of production which would enable the farmer or the small contractor to make his own cement-rice hull concrete by simple means. It was felt that the following requirements must be met before any building material made from cement and rice hulls could be classed as satisfactory.

---

*John S. Norton and Carl H. Thomas.

1. Sufficient strength in compression and tension to meet ordinary structural requirements.
2. Lightweight so that it could be easily handled in the form of a building block.
3. Resistance to insects and rodents.
4. Resistance to flame.
5. Good weathering qualities so that expansion and contraction of exposed units would not cause excessive cracking.
6. High insulating properties.
7. Nail holding ability sufficient for all ordinary building purposes.
8. Surface texture that would facilitate the application of stucco or plaster.
9. A manufacturing cost comparable with that of other lightweight concrete.

Materials Used

Rice hulls	Average weight,		18	lbs.	per	cu.	ft.
Rice hull ashes	"	"	12.25	"	"	"	"
Portland cement	"	"	94.0	"	"	"	"
Hydrated lime	"	"	50.0	"	"	"	"

The rice hulls and rice hull ashes were obtained from a local rice mill. The rice hulls, having been mechanically removed from the rice, were mostly broken lengthwise. No attempt was made to separate the rice hulls according to size.

Mixing Procedure

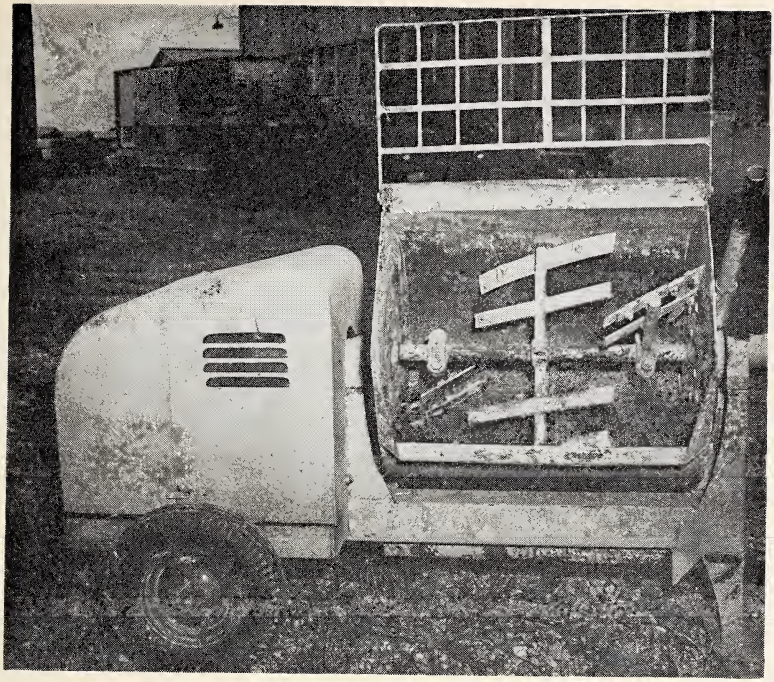
A rotary type, ½-cubic yard-capacity concrete mixer was first used. It was found, however, that the mix would adhere to the sides of the drum, preventing thorough mixing of the various ingredients. After careful investigation, it was finally decided to use a Muller Mortar Mixer, which did a consistently excellent job in preparing the mix ready for the molds.

The hulls were placed in the mixer, followed by the rice hull ash, and then the cement. The dry mass was mixed for several minutes and then enough water was added to obtain a workable consistency, with the mixer still running. The complete batch was then mixed for an additional five minutes. The amount of water added depended on the moisture content of the rice hulls and rice hull ashes and on the ratio of total aggregate to cement.

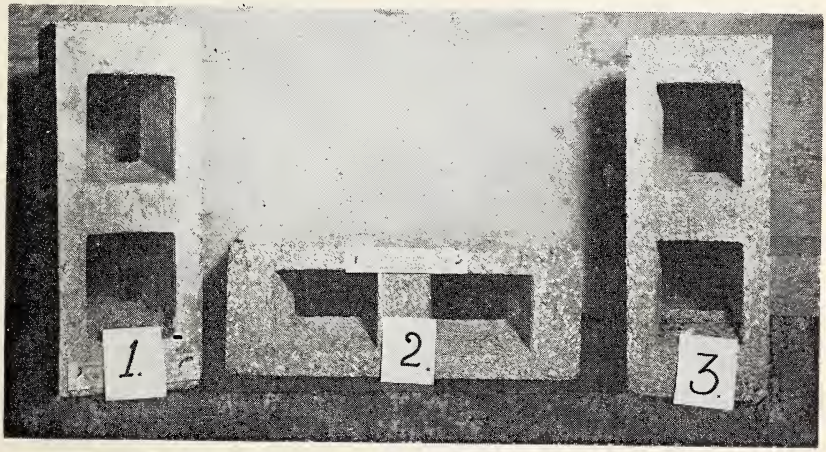
The Test Specimens

The test specimens used for the compression tests were cylinders, three by six inches. As the mix was placed in the molds, it received 20 tamps when one-third full, 20 tamps when two-thirds full and an additional 20 tamps when filled. It was allowed to remain in the mold until firm enough to stand, at which time it was removed for curing in wet sand.

The compression strength tests were made on a Tinus Olsen Testing machine at the stipulated times, as shown in Tables 2 and 3.



Muller Mortar Mixer Used for Mixing the Various Test Ingredients.



Building Blocks Made from Cement-Rice Hull Ash-Rice Hull Concrete. No. 1: 1-3-2 Mix, 3.2% Lime Added. No. 2: 1-2-3 Mix, 3.2% Lime Added. No. 3: 1-2-3 Mix, 3.0% Lime Added.

Definitions and Units

The compressive and tensile strengths are the maximum loads in pounds per square inch necessary to cause failure in the specimens.

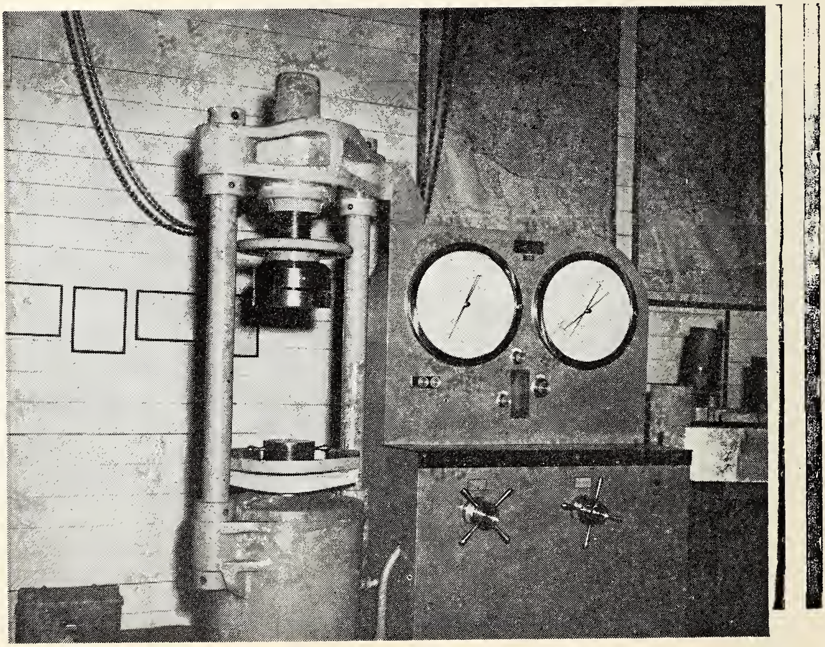
The thermal conductivity is the measure of the ability of the material to conduct heat. It will depend on the area exposed, the thickness, the time and the temperature difference, and must be expressed in these terms. Conductivity values based on the tests are designated as "K" values. They give the B.T.U. (British thermal unit) of heat transmittal in one hour when the flow is steady, through a section of the material one foot square in area, the thickness of the plate being one inch and the difference in temperature between the faces of the plate one degree Fahrenheit.

Out of the more than 100 tests made, 15 were selected as the basis for this report. It was felt that these 15 were typical of the results obtained and would accurately reflect the normal characteristics of cement-rice hull ash-rice hull concrete.

The Compressive Strength

The compressive strength is dependent to a large degree on the amount of cement used, although the nature of the aggregate used may also influence the strength owing to the size of the particles or by a possible effect on the hydration of the cement.

Table 1 lists the pertinent data of the 15 test samples used as a basis for this report.



Tinus Olsen Testing Machine Used for Compression Tests.

Figure 1 graphically shows the relationship between the compressive strength of the various mixes in pounds per square inch and the yield in cubic feet per sack of cement. Assuming that a building material should have a minimum strength in compression of 600 pounds per square inch, it is apparent that only six of the test mixes exceed this strength.

TABLE 1. Results of Fifteen Different Mixes

Batch number	Mix*	Water added (Gals. per sack)	Compressive strength (Lbs. per sq. inch)		Density (Lbs. per cu. ft.)	Yield (Cu. ft. per sack cement)
	C A H		7 days	28 days		
1	1 - 1 - 1	6.92	1090	1457	100.7	1.66
2	1 - 1 - 2	7.39	668	1020	94.3	2.09
3	1 - 1 - 3	9.70	290	360	81.6	3.05
4	1 - 2 - 1	6.40	737	1181	92.7	1.85
5	1 - 2 - 2	6.80	635	995	91.9	2.10
6	1 - 2 - 3	10.60	283	440	76.4	2.10
7	1 - 3 - 1	9.69	714	965	90.4	2.40
8	1 - 3 - 2	10.60	303	441	77.2	2.50
9	1 - 3 - 3	10.60	248	402	79.0	2.00
10	1 - 3 - 4	15.20	134	269	73.9	4.37
11	1 - 4 - 2	10.52	410	657	84.2	3.41
12	1 - 4 - 4	10.52	177	184	71.3	4.50
13	1 - 5 - 3	10.70	273	389	85.0	4.06
14	1 - 6 - 3	14.62	271	389	76.7	4.61
15	1 - 6 - 4	10.00	198	233	68.8	5.45

*C — cement; A — rice hull ash; H — rice hulls.

The yields of these six mixes are quite low, ranging from 1.66 cubic feet to 3.44 cubic feet. This would require 8 to 16 sacks of cement per cubic yard as compared to 5 to 10 sacks per cubic yard for ordinary concrete.

It may be noted that while the general trend indicates that the lower the yield, the greater the strength, which is normal, there is considerable fluctuation. It would seem that where rice hull ash is in excess of the volume of rice hulls, the yield is greater in proportion to the strength than where the volume of rice hulls is greater than the volume of rice hull ash.

It may be noted that the compressive strength at 7 days ranges from 1,090 pounds per square inch for the 1-1-1 mix to 134 pounds per square inch for the 1-3-4 mix. At 28 days the strength in compression ranges from 1,457 pounds per square inch for the 1-1-1 mix to 184 pounds per square inch for the 1-4-4 mix. The increase in compressive strength for the various mixes from 7 days to 28 days is far from uniform, as shown in Table 2 and in Figure 2. It would seem that in general where the volume of total aggregate to cement is constant, the compressive strength is affected by the ratio of rice hull ash to rice hulls. (See Table 3 and Figure 3.) Only six of the mixes, viz, 1-1-1, 1-2-1, 1-1-2, 1-2-2, 1-3-1 and 1-4-2, show sufficient strength to receive consideration as a building material.

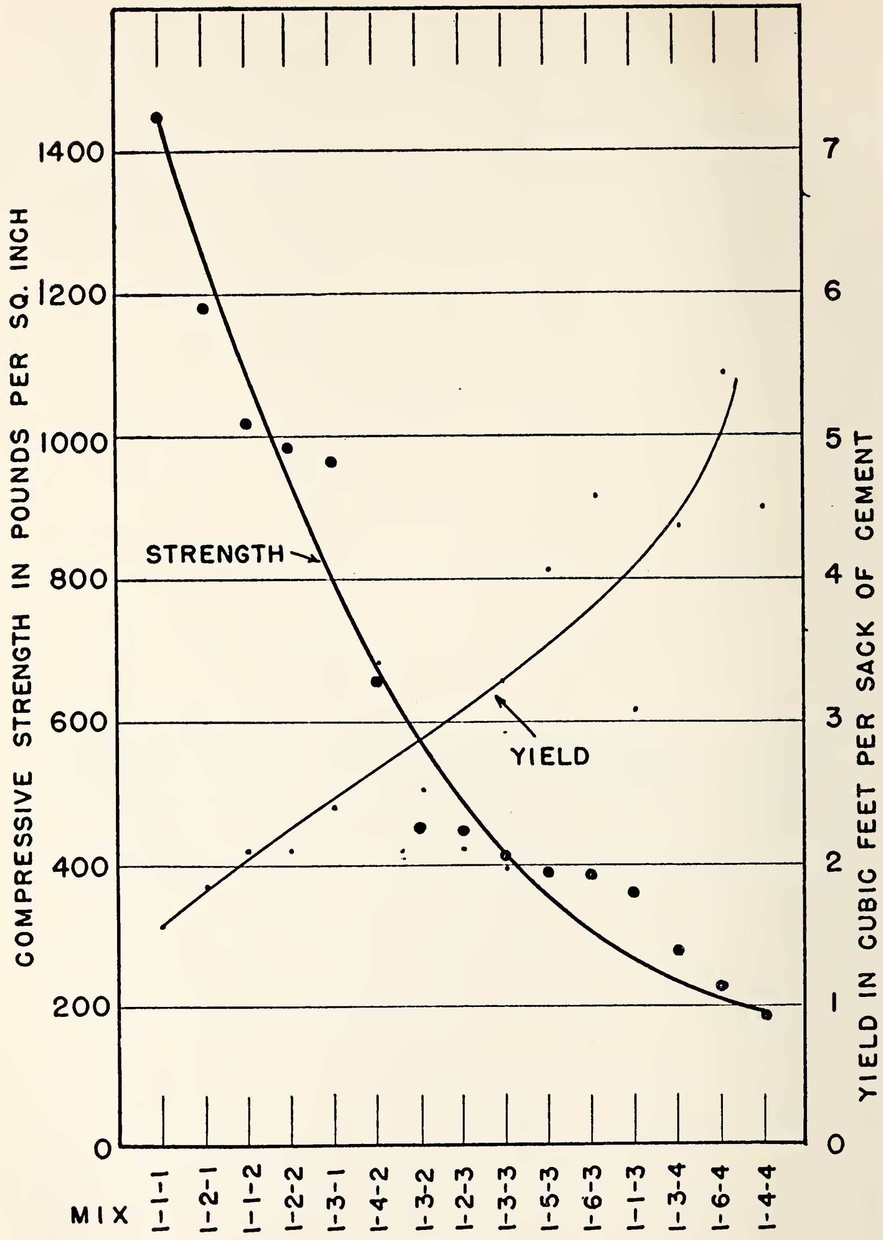


FIGURE 1. Relationship Between 28-Day Compressive Strength and Yield.

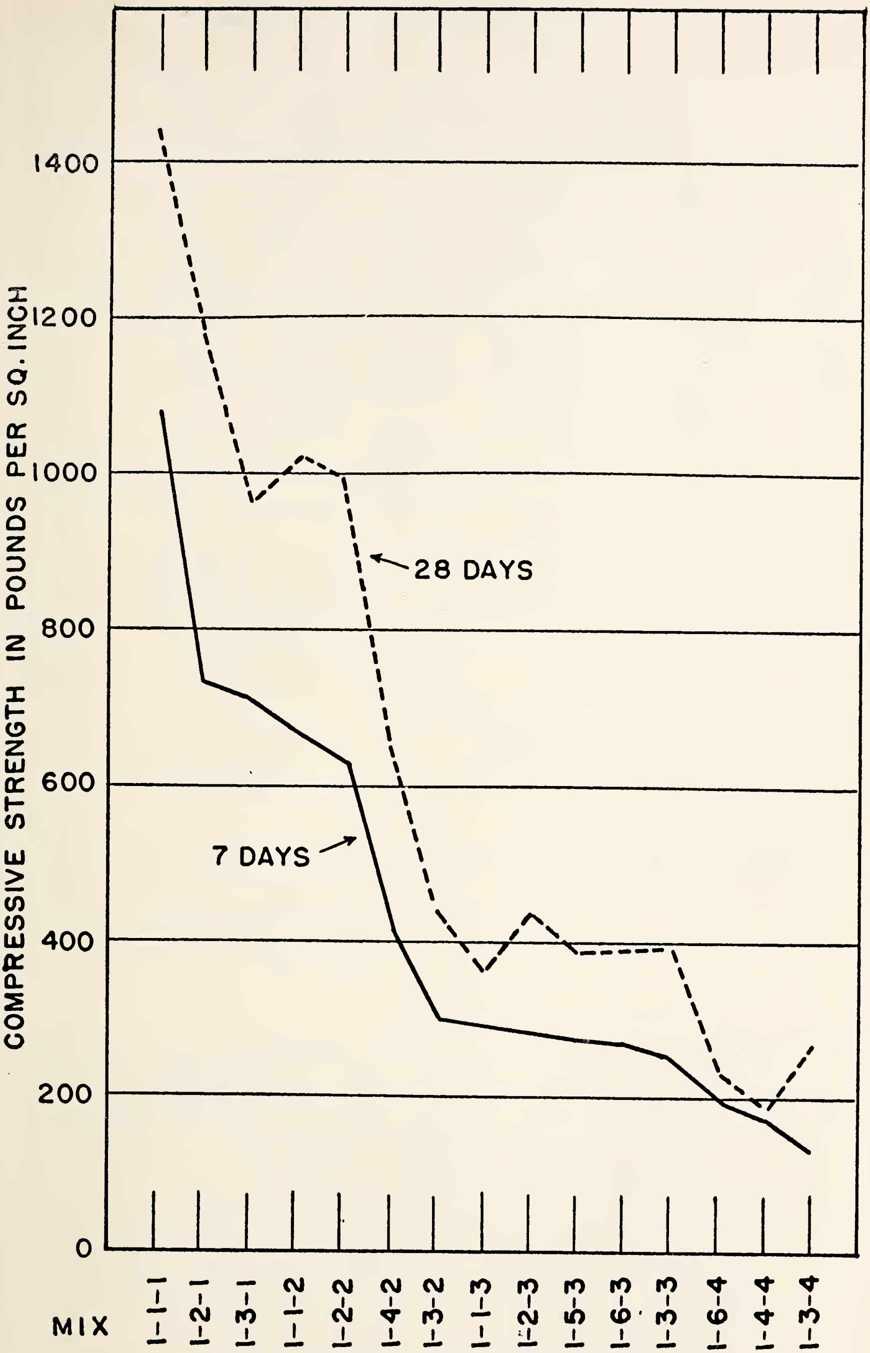


FIGURE 2. Compressive Strength, 7 Days and 28 Days.

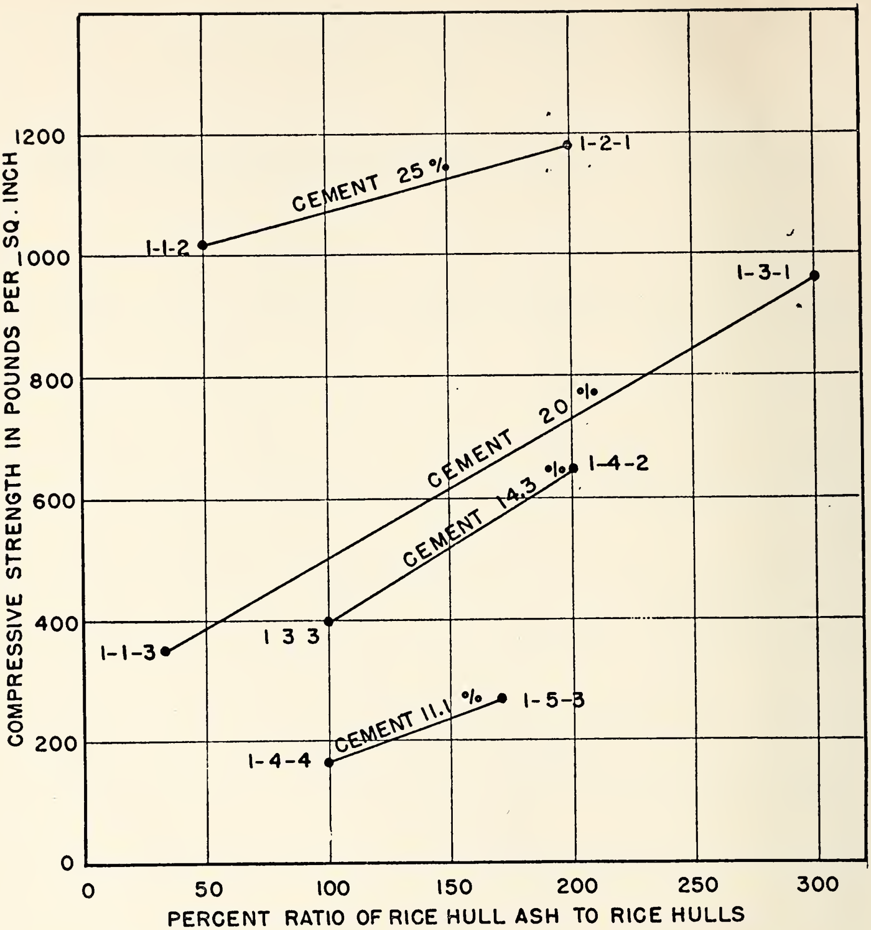


FIGURE 3. Effect of Ratio of Rice Hull Ash to Rice Hull on Compressive Strength.

Yield

The yield of concrete from the various mixes, in terms of cubic feet per sack of cement, must be considered as it directly affects the cost of the material. Concrete, using sand and gravel for the aggregate, will produce yields ranging from 4 cubic feet per sack of cement for the fairly rich mixes to 7 cubic feet for the lean mixes. It will be noted from Table 1 that none of the six mixes which show the desired strength show yields as high as 4 cubic feet. The 1-4-2 mix, with a strength in compression of 657 pounds per square inch and a yield of 3.41 cubic feet per sack of cement, comes the closest to an economical yield but falls far short of the desired results.

TABLE 2. Comparison of Compressive Strength at 7 Days and 28 Days (Mixes Listed in Order of Strength at 7 Days)

Batch number	Mix* C A H	Compressive Strength 7 days	Compressive Strength 28 days	Per cent increase in strength	Per cent composition by volume: Cement	Rice hull ash	Rice hulls
1	1 - 1 - 1	1,090	1,457	33.7	33⅓	33⅓	33⅓
4	1 - 2 - 1	737	1,181	60.2	25	50	25
7	1 - 3 - 1	714	965	35.2	20	60	20
2	1 - 1 - 2	668	1,020	52.7	25	25	50
5	1 - 2 - 2	635	995	56.7	20	40	40
11	1 - 4 - 2	410	657	60.2	14.3	57.2	28.5
8	1 - 3 - 2	303	441	45.5	16.7	50.1	33.2
3	1 - 1 - 3	290	360	24.1	20	20	40
6	1 - 2 - 3	283	440	55.5	16.7	33.3	50
13	1 - 5 - 3	273	389	42.5	11.1	55.6	33.3
14	1 - 6 - 3	271	389	43.5	10	60	30
9	1 - 3 - 3	248	402	62.1	14.3	42.85	42.85
15	1 - 6 - 4	198	233	17.7	9.1	54.6	36.3
12	1 - 4 - 4	177	184	3.9	11.2	44.4	44.4
10	1 - 3 - 4	134	269	100.8	12.5	37.5	50

*C — Cement; A — rice hull ash; H — rice hulls.

TABLE 3. Effect of Rice Hull Ash-Rice Hull Ratio on Compressive Strength when Per Cent of Cement by Volume Is Constant

Batch number	Mix* C A H	Per cent cement by volume	Ratio ashes to hulls (per cent)	Compressive strength 7 days	Compressive strength 28 days
2	1 - 1 - 2	25	50	668	880
4	1 - 2 - 1	25	200	737	1181
3	1 - 1 - 3	20	33.33	290	360
7	1 - 3 - 1	20	300	714	965
9	1 - 3 - 3	14.3	100	248	402
11	1 - 4 - 2	14.3	200	410	657
12	1 - 4 - 4	11.1	100	177	184
13	1 - 5 - 3	11.1	170	273	389

*C — Cement; A — rice hull ash; H — rice hulls.

Density

The density of the cement-rice hull ash-rice hull concrete ranged from 69 pounds per cubic foot to 101 pounds per cubic foot, as compared with 150 pounds per cubic foot for sand-gravel-cement concrete. Lightweight concretes that use slag, clay or cinders range in weight from 40 to 110 pounds per cubic foot.

Effect of Adding Lime

In an attempt to increase the strength of the material, lime was added to some of the mixes. Table 4 and Figure 4 show that the strength was increased considerably in all but two tests, where an actual decrease was shown. Since lime is one of the principal materials used in the manufacture of Portland cement, it seems surprising that additional

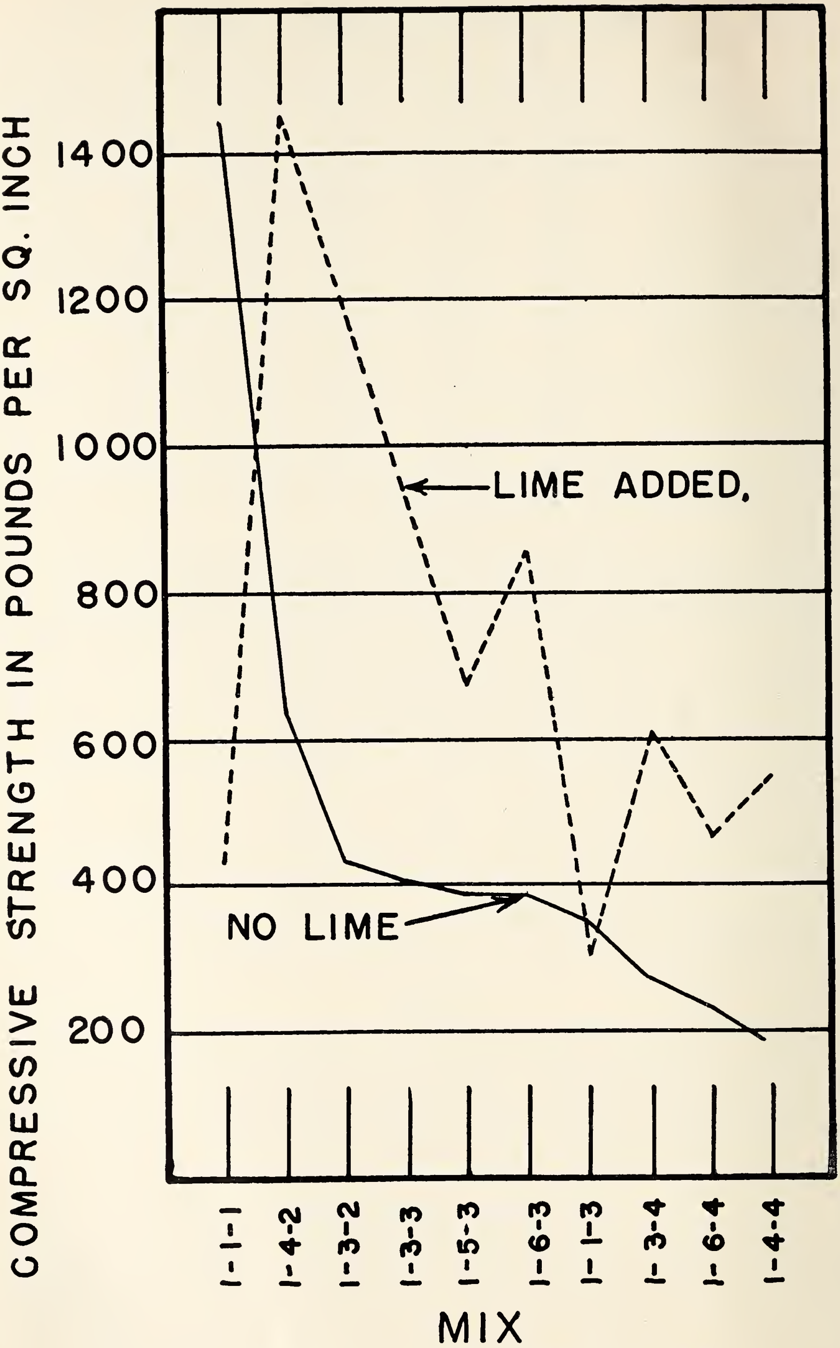


FIGURE 4. Effect of Lime on Compressive Strength at 28 Days.

lime should cause an increase in strength. It may be that the lime originally present is in some form other than free lime and that lime added increased the hydration of the cement, thus increasing the strength. The addition of small amounts of lime had no apparent effect on the strength, so larger amounts, as shown in Table 4, were added. In each case the amount of lime added was equal in volume to the amount of cement used. Seemingly, lime added in excess of 15 per cent, by volume, of the total mix had an adverse effect, and the greatest increase in strength occurred with the addition of 10 per cent of lime. However, the lime-treated concrete cracked so badly after being exposed to the weather that it was considered unsuitable as a building material.

TABLE 4. Effect of Adding Lime

Batch number	Mix (by volume)* C A H	Percentage of lime added (By volume of total mix)	Compressive · strength 28 days Without lime	With lime
1	1 - 1 - 1	25.0	1457	452
11	1 - 4 - 2	12.5	657	1464
8	1 - 3 - 2	14.3	441	1200
9	1 - 3 - 3	12.5	402	942
13	1 - 5 - 3	10.0	389	680
14	1 - 6 - 3	9.0	389	875
5	1 - 1 - 3	16.6	360	289
10	1 - 3 - 4	11.0	269	606
15	1 - 6 - 4	8.3	233	469
12	1 - 4 - 4	10.0	184	551

*C — cement; A — rice hull ash; H — rice hulls.

Thermal Conductivity

The thermal conductivity of a material such as cement-rice hull ash-rice hull concrete depends on the conductivity of each of the materials and on the method by which the materials were bonded together.

Tests were made of five samples of cement-rice hull ash-rice hull concrete. It will be noted from Table 5 that a rather wide range of values was calculated. Because of the surface roughness of this type of concrete, it was difficult to secure airtight contacts for the instruments used, and some errors may have occurred. However, it can be safely assumed that the 'K' value is close to 1.0 B.T.U./hr/ft^2/°F/in. This compares very favorably with the 'K' of 12.6 for sand and gravel concrete and with the 'K' value of 2.29 for lightweight concretes.

TABLE 5. Thermal Conductivity ('K')

Test number	Source temp. (°F.)	Thickness of specimen (in.)	Slope of curve on semi-log graph (cm-sec/cm)	'K' value calculated (cal/sec/cm^2/°C/cm)	'K' (BTU/hr/ft^2/°F/in)
1	212	0.42	18,980	0.000267	0.775048
2	32	0.36	29,530	0.0001476	0.428453
3	212	0.582	18,200	0.000382	1.140
4	212	0.582	24,160	0.000288	0.8360
5	212	0.675	25,400	0.0003173	0.9220

Average value of 'K' with source at 212° F = 0.000318 cal/sec/cm^2/°C/cm
= 0.912 BTU/hr/ft^2/°F/in

Conclusions From First Experiments

From tests made in these studies the following conclusions are indicated:

1. Safe strengths may be obtained from cement-rice hull ash-rice hull mixtures.
2. The addition of certain amounts of dehydrated lime increases the strength but causes severe cracking of the concrete.
3. The cement-rice hull ash-rice hull material is a better thermal insulator than ordinary concrete but does not have as high a strength.
4. In order to obtain adequate strength in the cement-rice hull ash-rice hull material, it is necessary to use such a rich mix (large cement content) that the cost, even though rice hulls can be obtained at no cost, will be greater than that of other concretes.
5. It was found that similar mixes prepared at different times had varying results to a degree that reactions of any one mix could not be reliably forecast. Unless definite strength results can be obtained under normal mixing conditions, it would not be safe to advocate production and use by the farmer.
6. At this time cement-rice hull ash-rice hull concrete cannot be recommended as a building material. Based on available information it does not appear to be either stable or economical.

Use of Rice Hull Ashes in Adobe Bricks

In 1953 a second attempt was made to utilize rice hulls in a structural brick, reaching back through the years to the mud or adobe type brick which is dried and cured in the sun. The use of earth as a building material is at least as old as recorded history. Whenever climatic conditions have been favorable it has proved an excellent choice. Strength increases with age, repairs are easily made and insulating qualities are high. However, since earth is readily soluble in water, the successful use of adobe bricks was restricted to very dry areas until lately when a means of stabilizing the soil was discovered. Stabilizing means coating the soil molecules so they will be impervious to moisture. Soil can be stabilized by adding cement or emulsified asphalt or with specially dehydrated molasses (Plasmofalt). The emulsified asphalt is commercially obtainable as "Bitudobe Stabilizer" prepared by the American Bitumels Company and has proved very successful in the making of stabilized adobe blocks, particularly in California.

A search of available records indicated that soils containing the proper proportions of clay and sand would make an excellent building material, and when stabilized would be impervious to water. Apparently soils ranging from 40 per cent to 75 per cent sand content were satisfactory with the optimum being 75 per cent. It was found that sand could be added to clayey soils with satisfactory results, but attempts to add clay to sandy soil were not too successful.

Possibilities in Louisiana

Many of the Louisiana soils have a high clay content and would not be satisfactory for soil bricks unless sand were added. This is unfortunate since many farm buildings, especially poultry houses, would readily lend themselves to this type of construction. In fact, a stabilized soil brick, impervious to the moist Louisiana climate, should prove to be a valuable building material on the farm.

It was believed there might be means, other than adding sand, of conditioning the common types of Louisiana soils, thereby making them suitable for soil bricks. In using rice hulls or rice hull ashes as an aggregate, it was found that rice hulls, being organic, were unsuitable, but when reduced to ash take on characteristics somewhat similar to a fine sand but with a much lower density. By mixing the rice hull ashes, instead of sand, with the clay soils, we might have a mixture that could be utilized as a low-cost building material on the farm. If this mixture were stabilized, it could be used in the moist climate of Louisiana.

Preliminary Work

As a first step, criteria for minimum results were established as follows:

(a) Mixture should be cast in brick form and of a size that would promote ease in handling and using.

(b) Bricks should be of medium hardness, sound and reasonably true to size without detrimental cracks and pits.

(c) Shrinkage cracks should be not more than three inches long and one-eighth inch wide, with not more than three cracks per brick.

(d) Minimum strength in compression should be 300 pounds per square inch.

(e) Moisture absorption should be less than 2½ per cent of dry weight, with one face in direct contact with water for not less than seven days.

(f) Erosion should be less than 1/16 inch without pitting when brick is exposed to a needle spray of water at 20 pounds per square inch pressure for at least three hours.

(g) Density of material, when fully cured, should be not more than 90 pounds per cubic foot and should be less if possible.

(h) Cost per cubic yard of soil used (approximately 120 bricks), including labor and materials, in 1956, was not more than $10.

(i) The finished brick should be capable of receiving paint, whitewash or stucco.

(j) Production methods should be simple and noncritical so that any farmer could make the bricks.

(k) A substantial amount of agricultural waste must be used in the process.

The second step was to select some common soils for testing as to inherent qualities for making adobe type bricks. Four soil types were used:

1. Miss. Bluff from the Baton Rouge area (18% sand, 82% clay & silt).
2. Coastal Prairie from the Crowley area (8% sand, 92% clay & silt).
3. Coastal Plains from the Calhoun area (65% sand, 35% clay & silt).
4. Miss. River Bottom (22% sand, 78% clay & silt).

Testing, Soil Only

A plastic mud made from each soil type was poured into molds 4" x 4" x 2" high. When the mixture was well set, the molds were removed and the blocks allowed to cure. At the end of 24 hours, the blocks were set enough so they could be raised on one edge in order to expose more surface for drying. At the end of 7 days the blocks made from soil type No. 1 were firm, the surface was even and no cracks were visible. Those made from soil type No. 2 were rough in appearance and several large cracks were visible. Blocks made from soil type No. 3 were even in appearance but were exceedingly friable on the surface. Soil type No. 4 blocks showed excessive shrinkage and were badly warped. No. 1 and No. 3 soil type blocks shrank very slightly, and No. 2 soil type blocks showed moderate shrinkage.

Compressive Strength Tests—Tests for strength in compression were made at the end of 14 days, 28 days and 60 days. In each case three blocks of each type were tested, and the average strength is shown in the following table of results.

Average Strength in Compression of Soil Blocks Made from Four Different Soil Types

Soil Type	P.S.I., 14 days	P.S.I., 28 days	P.S.I., 60 days
1	275	340	365
2	326	410	460
3	301	389	410
4	125	160	201

It may be noted that in soil types 1, 2 and 3 the greatest increase in strength occurs during the first month and that the increase during the second month is considerably less.

Erosion Tests—The blocks were then tested for erosion by exposing them to a needle spray of water at a constant pressure of 20 pounds per square inch. All blocks were allowed to remain under the spray until they were completely disintegrated. Again three blocks of each type were tested and the average of three used for the record. The time lapse in minutes for complete disintegration was as follows:

Erosion Test
(Needle spray at 20 P.S.I.)

Soil Type	Time lapse in minutes	Soil Type	Time lapse in minutes
1	30	3	32
2	21	4	16

At this point No. 4 soil type was temporarily eliminated as being too weak for present consideration.

Testing Soil Mixed With Rice Hull Ashes Only

Each of the three remaining soil types was mixed with rice hull ashes in varying proportions and enough water added to make a plastic mass. As a rough measure of reaction, it was decided to try the following proportions:

(a) 1 part soil and 1 part ash by volume
(b) 2 parts soil and 1 part ash by volume
(c) 1 part soil and 2 parts ash by volume

The results were as follows:

	Soil Type	Compressive Strength		
		14 days	28 days	60 days
Mix (a)	1	215	317	345
	2	275	351	401
	3	165	218	263
Mix (b)	1	236	328	351
	2	289	372	412
	3	223	364	391
Mix (c)	1	179	231	236
	2	196	239	251
	3	124	163	210

Mix (b) gave the best results in compressive strength, but it was very little greater than the results from Mix (a). Mix (c) showed a decided weakness and was eliminated from further consideration at that time.

Since our objective was to use as much rice hull ash as possible, it was decided to use Mix (a) in our next tests.

It is worthy of note that the addition of rice hull ashes in the 1 to 1 ratio reduced the strength of the original soils very little, but density was reduced some 25 per cent.

Testing Soil Mixed With Rice Hull Ash and Emulsified Asphalt

Emulsified asphalt was added to a mixture of rice hull ashes and type No. 1 soil in the varying amounts considered applicable. After thoroughly mixing by hand, enough water was added to produce a plastic mass and the resulting mixture was poured into the molds. After curing, the stabilized blocks were tested by three methods. First, they were given an accelerated weathering test by alternately freezing the blocks solid and then quickly thawing them out in 70° F. water, one freezing and one thawing completing a cycle. The number of cycles that each test block could withstand before showing signs of breakdown was used as the basis for comparing resistance to weathering. Any blocks that were in good shape after 20 cycles were tentatively classed as acceptable. Second, the test blocks were subjected to a needle spray of water at 20 pounds per square inch to determine the comparative resistance to erosion. Any block that remained in good shape at the end of 24 hours was tentatively classed as acceptable. Third, test blocks were placed

TABLE 6. Results of Preliminary Tests on 4" x 4" x 2" Blocks

Test series No.	Type of soil	Per cent sand & clay		Mix proportion				Initial drying time	Accel-erated weathering test	Erosion test	Moisture absorption test	Compressive strength, P.S.I.		
												(Days)		
		*Sa	Cl.	S	A	B	C	Hours	Cycles	Hours	% Dry Wt.	14	28	60
4	1	18	82	1	1	3%	0	5.0	6	2	4.8	249	371	385
5	1	18	82	1	1	4%	0	5.5	9	2	2.5	242	365	379
6	1	18	82	1	1	5%	0	7.0	10	5	1.7	233	365	380
7	1	18	82	1	1	7%	0	7.0	20p	72p	1.4	245	361	390
8	1	18	82	1	1	10%	0	9.5	20p	72p	1.4	242	352	391
9	1	18	82	1	1	15%	0	13.0	20p	72p	1.3	245	350	402
10	1	18	82	1	1	0	3%	5.0	4	1.5	2.6	233	301	325
11	1	18	82	1	1	0	5%	4.5	4	2	2.6	229	300	315
12	1	18	82	1	1	0	10%	2.0	20p	72p	2.1	120	198	211
13	1	18	82	1	1	0	15%	1.0	20p	72p	1.8	122	175	183
14	1	18	82	1	1	7%	5%	5.0	20p	72p	1.3	203	280	301
15	1	18	82	1	1	7%	10%	2.5	20p	72p	1.4	215	260	298
16	1	18	82	1	1	7%	15%	1.0	20p	72p	1.2	207	249	275
17	2	8	92	1	1	7%	0	7.0	20p	72p	1.6	311	471	508
18	2	8	92	1	2	7%	0	6.0	18	36	1.9	270	298	415
19	2	8	92	2	3	7%	0	6.0	20p	72p	2.0	352	401	556
20	3	65	35	1	1	7%	0	4.0	6	13	2.3	182	215	299
21	3	65	35	1	2	7%	0	7.0	4	12	2.6	120	168	175
22	3	65	35	2	1	7%	0	4.0	13	25	2.1	185	260	290
23	3	65	35	3	1	7%	0	4.0	19	42	1.8	192	273	301
24	Blend	15	85	1	1	7%	0	7.0	18	72p		230	340	352
25	Blend	20	80	1	1	7%	0	7.0	20p	72p		228	347	368
26	Blend	30	70	1	1	7%	0	6.5	20p	72p		215	332	349
27	Blend	40	60	1	1	7%	0	5.5	20p	72p		222	330	356
28	Blend	50	50	1	1	7%	0	4.0	20p	72p		201	299	316
29	Blend	60	40	1	1	7%	0	4.0	16	49		168	251	286

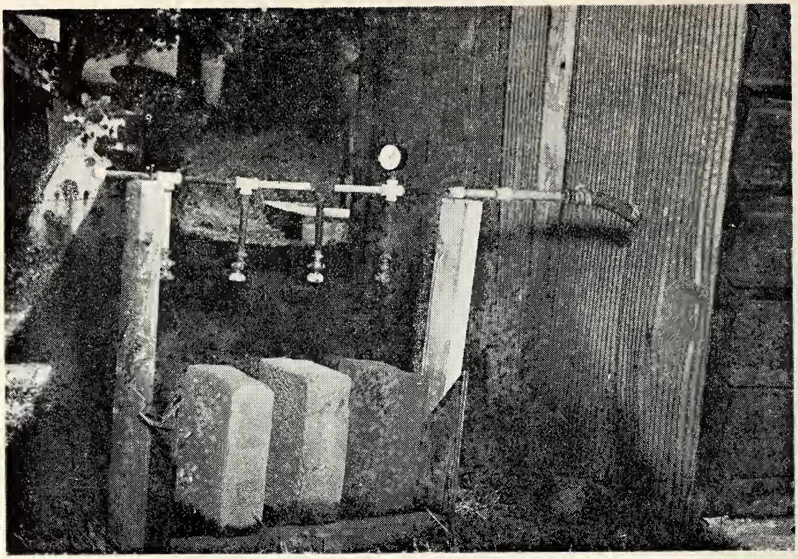
(Continued)

TABLE 6. (Continued)

Test series number	REMARKS
4.	Strength satisfactory but resistance to weathering too low.
5.	Strength satisfactory but resistance to weathering too low.
6.	Strength satisfactory but resistance to weahering too low.
7.	Strength satisfactory and resistance to weathering and erosion satisfactory.
8.	No apparent gain by using more than 7% emulsified asphalt.
9.	Slight gain in compressive strength but not enough to justify increased cost.
10.	Strength satisfactory but resistance to weathering too low.
11.	Strength satisfactory but resistance to weathering too low.
12.	Compressive strength too low. This block was very brittle.
13.	Compressive strength too low. This block was very brittle.
14.	No apparent advantage in combining cement with emulsified asphalt.
15.	Compressive strength too low.
16.	Compressive strength too low.
17.	Very tough hard block. Necessary to pulverize soil in hammer mill before using.
18.	Resistance to weathering too low.
19.	Excellent block. Difficult soil handling and severe cracking only objections.
20.	Block too weak in all respects.
21.	Block too weak in all respects.
22.	Sand content of soil apparently too high for addition of ash.
23.	Sand content of soil apparently too high for addition of ash.
24.	This series of tests was run to determine the approximate minimum and maximum sand content of soils that would allow the addition of one part rice hull ash and yet meet the required tests. Results indicate that soils having not less than 15% sand nor more than 50% sand content produce satisfactory results.
25.	
26.	
27.	
28.	
29.	

*Note: Sa — sand; Cl — clay; S — soil; A — rice hull ash; B — emulsified asphalt; C — Portland cement; p — indicates that no signs of deterioration were apparent at the end of the period as shown in the table.

A sample analysis of the various soils was made by washing through a 200-mesh screen. All materials passing through the screen were classed as clay and all materials remaining on the screen were classed as sand.



Water Spray Unit Used for Testing Resistance of Soilash Bricks to Erosion

in a pan containing water so that one large face was completely immersed in the water. At the end of seven days the amount of water absorbed was measured and, if it was less than 2½ per cent of the dry weight of the block, that block was classed as acceptable. (See tests 4 to 9, inclusive, Table 6.)

It was found that optimum results were obtained when 7 per cent by volume of emulsified asphalt was added. Amounts greater than 7 per cent did not increase favorable characteristics of the blocks enough to make the larger amounts economically justifiable. Amounts less than 7 per cent did not provide sufficient stabilization against moisture.

It was noted that the test blocks dried much slower when emulsified asphalt was added than they did in the first tests when no emulsified asphalt was used. In fact, they took three to four times as long to dry to a point where they could be removed from the mold and set on edge to cure. However, once the initial drying period was completed, they apparently cured as fast as the unstabilized blocks.

It was decided, therefore, to deviate slightly at this time and make some tests using Portland cement and a mixture of Portland cement and emulsified asphalt as possible stabilizing agents. It was felt that the cement might act as a dehydrating agent also and accelerate the initial drying period. (See tests 10 to 16 inclusive, Table 6.) Cement added in amounts less than 10 per cent by volume did not materially reduce the drying time. The 10 per cent addition reduced drying time to approximately one-half and 15 per cent reduced it still further. However, when these blocks were subjected to compressive strength tests, it was found they were below minimum acceptable strength of 300 p.s.i. Although microscopic examination showed no difference in texture as compared to the blocks stabilized with emulsified asphalt only, it was thought that some granulation effect caused by the quick setting cement was responsible for the loss of compressive strength.

Tests on blocks treated with both emulsified asphalt and cement evidenced the same loss of strength. It was decided, therefore, to eliminate the use of cement and to conduct further tests using emulsified asphalt only.

Testing Soil Type No. 2, Rice Hull Ashes and Emulsified Asphalt

Soil type No. 2 was difficult to handle after it was dried out in the storage pile, as it had formed extremely hard clumps. Hosing down with water over a period of several days did not reduce it to a usable state. Therefore, it was necessary to pulverize it in a hammer mill. Although excellent results in compressive strength were obtained, it was found that during the initial drying period the blocks cracked and warped so badly they were classed as unsatisfactory and further tests were temporarily discontinued. (See tests 17 to 19 inclusive, Table 6.)

Testing Soil Type No. 3, Rice Hull Ashes and Emulsified Cement

These tests, in addition to those previously made, seemed to prove conclusively that the percentage of sand in this soil was at such a high point that the addition of rice hull ash in any quantity at all weakened the block to a point considerably below tolerance. Soil type No. 3 was classified as unusable for our purpose. (See tests 20 to 23 inclusive, Table 6.)

Testing Blended Soils, Rice Hull Ashes and Emulsified Asphalt

In an endeavor to determine the maximum and minimum limits of sand content of soils that would allow the satisfactory addition of rice hull ashes in a 1 to 1 ratio, several soils were blended with sand to give six soil types ranging from 15 per cent sand and 85 per cent clay to 60 per cent sand and 40 per cent clay. Blocks were made from each blend and were subjected to the usual tests. Test No. 24 with the lowest sand content and test No. 29 with the highest sand content did not show the desired characteristics. Tests No. 25 to 28 inclusive showed results that were favorable and surprisingly similar. It was tentatively decided on the basis of these results that any soil having a sand content of not less than 15 per cent nor more than 60 per cent could be blended with rice hull ashes and produce satisfactory results, and that optimum results could be expected from soil having from 18 per cent to 50 per cent sand content.

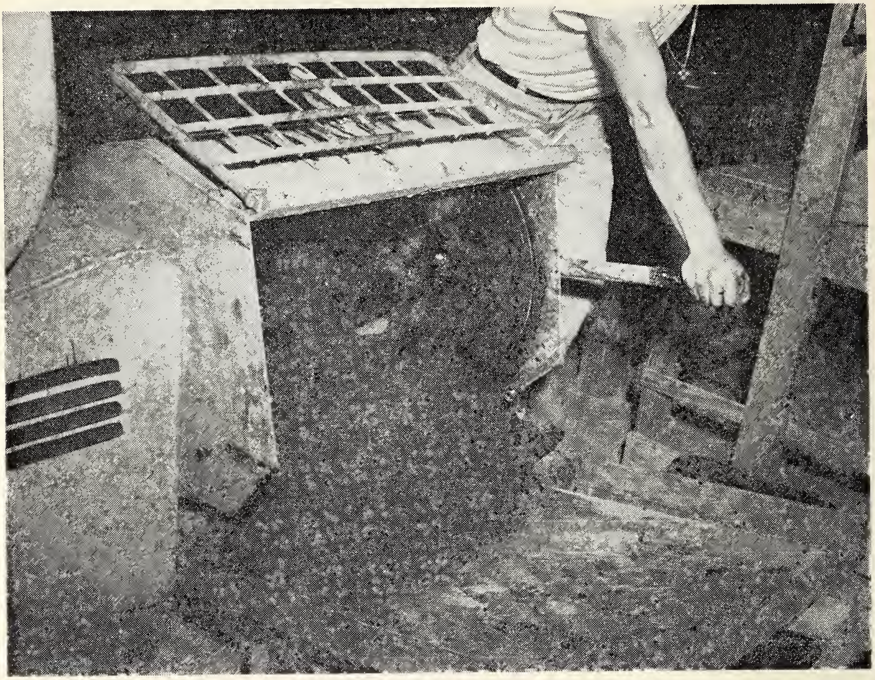
Producing Full-Size Blocks for Actual Building Tests

So far all preliminary research had been done in the laboratory. Test block sizes were 4" x 4" x 2" high. The various ingredients were all mixed by hand and the blocks were dried and cured in the laboratory.

Our next step was to produce full-size bricks which would be made under normal production conditions and would be allowed to cure on the outside. It was decided to use a block size of 8" x 12" x 4" high.

For the first batch a ⅛-cubic yard concrete mixer was used to mix the various ingredients. It was discarded when it proved incapable of thoroughly mixing the soil, rice hull ashes and water, because of mechanical design. A Muller mortar mixer was then tried and found to be satisfactory.

Since there was an ample supply of soil type No. 1, it was decided to work with this soil first. Each batch mixed consisted of 1 cubic foot of soil and 1 cubic foot of rice hull ashes. These were placed in the mixer and mixed until thoroughly blended. Enough water was then added to produce a plastic mass. Last, the emulsified asphalt was added on the basis of 7 per cent by volume of the soil content. Twenty full-size blocks were cast and allowed to cure for 28 days. Although the mix appeared to be plastic when removed from the mixer, it did not puddle well into the molds and the resulting bricks were slightly honeycombed. An additional 20 bricks were cast from a mix containing a greater amount of water and this puddled into the molds much more easily than the first mix. When the molds were removed, the surfaces of the bricks from the second mix were much smoother. The bricks dried very slowly, so no compressive strength tests were made at the end of 14 days. At the end of 28 days four bricks from each batch were tested for strength, and at the end of 60 days four more bricks from each batch were tested. (See



Pouring Soilash Mix from the Muller Mortar Mixer. This Type Mixer Proved Most Satisfactory.

TABLE 7. Testing Full-Size Bricks Made from Soil Type No. 1

Test series number	Water per cu. ft. soil	Mix proportion			Initial drying time	Weathering & moisture tests	Compressive strength P.S.I.		Density lbs. per cu. ft.
	Gals.	*S	A	B	Days		28 days	60 days	
30	2.0	1	1	7%	4	Satisfactory	205	248	74.2
31	2.5	1	1	7%	5	”	205	237	72.7
32	3.0	1	1	7%	7	”	180	210	70.9
33	3.5	1	1	7%	7	”	176	205	70.2
34	2.5	1	1	7%	4	”	251	275	72.1
35	3.0	1	1	7%	5	”	246	263	69.8
36	2.0	1	1	7%	4	”	221	230	71.1
37	2.5	1	1	7%	6	”	218	242	71.3
38	2.0	1	1	7%	4	”	269	315	72.3
39	3.0	1	1	10%	5	”	273	338	73.0
40	3.0	1	1½	10%	5	”	262	290	66.4
41	4.0	1	2	10%	8	”	228	271	64.7

The Order in Which the Various Ingredients Were Added

Test series number	REMARKS
30	Soil and ash mixed together, water added, asphalt added.
31	Soil and ash mixed together, water added, asphalt added.
32	Water and asphalt mixed together, soil added, ash added.
33	Water and asphalt mixed together, soil added, ash added.
34	Soil and ash mixed together, asphalt added, water added.
35	Soil and ash mixed together, asphalt added, water added.
36	Soil and ½ water mixed together, ash added, ½ water and asphalt added.
37	Soil and ½ water mixed together, ash added, ½ water and asphalt added.
38	Asphalt and ½ water mixed together, soil added, ash and ½ water added.
39	Asphalt and ½ water mixed together, soil added, ash and ½ water added.
40	Asphalt and ½ water mixed together, soil added, ash and ½ water added.
41	Asphalt and ½ water mixed together, soil addded, ash and ½ water added.

*S — soil; A — rice hull ash; B — emulsified asphalt.

NOTE. It will be seen from the above results that density and strength do not increase and decrease in proportion as is the case with most masonries and concretes. This tends to bear out the supposition that the order in which ingredients are added is of the utmost importance.

tests 30 and 31, Table 7). The average compressive strength at 60 days was 242.5 p.s.i.

Since this strength was far below the strength obtained from a similar mix when used in the laboratory to make the small test blocks, it was felt that the ingredients had not been mixed long enough, so the preceding tests were duplicated with the batches remaining in mixer 10 minutes after a visual inspection indicated all ingredients were thoroughly combined. Strength test results were again disappointing. Feeling that a complete coating of the soil particles with the emulsified asphalt was not taking place and that the clay colloids were not being wetted sufficiently to promote adhesion, it was decided to try different amounts of water. At the same time the various ingredients were added in different order.

After making several more tests with disappointing results (see tests 32 to 38 inclusive, Table 7), it was decided to add one-half of the amount of water required to the emulsified asphalt and mix thoroughly before adding any solids. The soil was then added and mixed until the liquid was completely absorbed. Then the rice hull ash was added and allowed to mix with the saturated soil until the mix was so stiff that the mixer began to labor. At this point the remaining water was added and the whole allowed to mix until a plastic mass was formed. (See test 38, Table 7.) All bricks made by this method were satisfactory.

Effect of Adding a Greater Amount of Emulsified Asphalt

A test was conducted to determine the effect of adding 10 per cent emulsified asphalt instead of the 7 per cent previously used. The result was a gain in strength. This test was repeated and again showed a gain in strength. Bricks from these batches were subjected to the erosion and moisture absorption tests and found to be satisfactory. Since the emulsified asphalt is the most expensive single item, its use should be held to a minimum consistent with the desired results. However, the greater strength seems to justify this slight increase from 7 per cent to 10 per cent. (See tests 38 and 39, Table 7.)

Summary of Results

Because of the time required to cure the soil bricks before they can be tested and because we were working more or less in the dark at the start of this research project, progress so far has been slow. A concrete slab was poured to form a foundation for a small building which is now under construction, using the soil bricks for the walls. The reaction of the bricks under actual building conditions should provide us with sufficient data to determine whether or not they are practical. In the meantime, this concrete slab has been used to erect small wall sections of the bricks left over from the various tests so that their resistance to weathering could be observed. To date they have all proved resistant to rain, wind and sun.

On the basis of the test results and visual observation of the test walls, it is safe to state that a satisfactory soil-rice hull ash building brick can be made from any soil containing not more than 85 per cent clay nor less than 40 per cent clay and that such a brick can be stabilized to meet Louisiana climatic conditions by adding the correct amount of emulsified asphalt.

The present recommendation for mix proportions is as follows: 1 part soil, 1 part rice hull ash and 10 per cent emulsified asphalt by volume of the soil content. In actual practice this would be 1 cubic foot of soil, 1 cubic foot of rice hull ash and 3/4 gallon of emulsified asphalt, with enough water added to obtain a plastic, easily worked substance. It was found that 2½ gallons of water per batch of 1 cubic foot of soil and 1 cubic foot of ash was the most satisfactory. Naturally, the moisture content of the soil at the time it is used will have some bearing on the total amount of water to be added. However, the water measure is not critical. Enough should be added in each case to make a mix that can be easily placed in the mold and worked against the sides and into the corners before filling in the center.

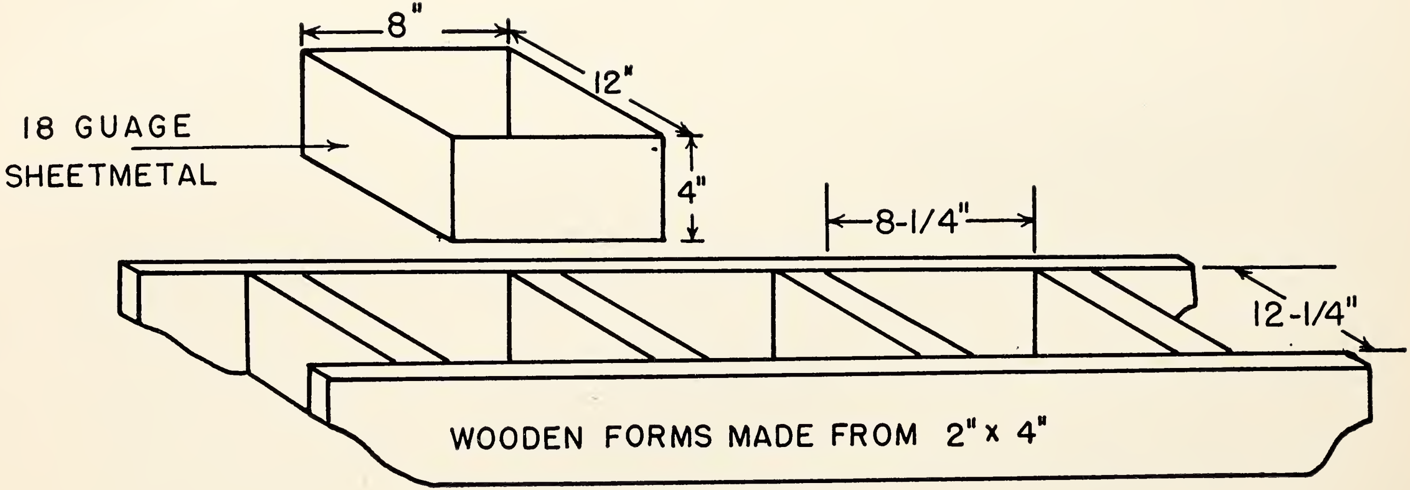
Mixing Procedure

The following order for adding the ingredients was found to produce the most satisfactory results.

Place one-half of the total water required and the total amount of emulsified asphalt into the mixer and allow to mix for three minutes. Add the soil and continue mixing until the soil is saturated with the water-emulsified asphalt liquid, which takes approximately five minutes. Then add the rice hull ash. Continue mixing until the rice hull ashes have been so thoroughly absorbed by the saturated soil that they seem to have completely disappeared. This will take from three to five minutes, and usually by this time the mix is very stiff. Add the remaining half of the water and continue mixing until a pliable plastic mass is produced. If it is necessary to add water in addition to the estimated required amount, add very slowly and in small quantities. Never add more water than is necessary to produce a workable mix.

Making the Molds or Forms

The molds can be made from wooden forms as shown in Figure 5. It is necessary to keep the interior surfaces clean and well oiled to prevent sticking. Used motor oil is good for this purpose. It was found more satisfactory to make removable sheet metal linings, as shown in Figure 5, and place these metal linings inside the wooden forms. The rigid wooden forms would support the sheet metal during the pouring period, and at the end of ten minutes the wooden form could be removed, leaving the sheet metal around the soft brick until it was set. Three wooden forms with three sections each were ample to take care of all the sheet metal linings used in one day's pouring.



ISOMETRIC VIEW OF FORMS USED FOR MOULDING BRICKS

FIG.5

Pouring and Curing the Bricks

The mix was scooped into each mold and well trowled into the corners and against the sides. Surplus mix was scraped off the top with a wooden float which left a fairly rough surface suitable for receiving mortar.

As soon as the bricks were firm enough to handle, they were turned on edge so that the greatest possible area was exposed to the air. (The sheet metal lining could be removed at the end of the day's pouring, but the brick, though stiff enough to prevent slump, was not firm enough to move.)

Filling Molds with Soil Ash Mixture.

Initial drying time varied from 4 to 8 days. Total curing time was approximately 28 days. This was considered to be too slow, and various methods of faster drying were tried. It was definitely established that the initial drying had to be slow. Otherwise, external strains were set up that caused severe cracks. It must be remembered that much more water is used in this process than would ordinarily be used in making conventional adobe bricks, and the excess moisture must be allowed to evaporate slowly. For this reason, it was impossible to dry the bricks in the open under direct sunlight. Covering with wet burlap did not retard the drying time sufficiently. It was found necessary to dry the bricks under shade for at least 7 days. They could then be moved out into the open under direct sun and allowed to cure. Any rain that fell on the bricks during the curing period after the initial drying in the shade had no adverse effect on them.

Yield

One cubic yard of soil and 1 cubic yard of rice hull ash made 1.14 cubic yards of brick material.

Density

The average density of soil ash is 70 pounds per cubic foot. This compares very favorably with adobe, 100-120 pounds per cubic foot, and concrete, 115-150 pounds per cubic foot.

Economic Factors

The cost factor is, of course, all important in the selection of any building material. Cost factors should include initial cost, maintenance and depreciation, and this actual cost should be compared to the value received in terms of protection against the elements.

A properly made soil block will provide sufficient strength for small buildings, such as tool sheds, poultry houses and cow barns, and will resist normal weather conditions. Over a period of years, the walls will actually gain in strength and tend to become monolithic in form. The insulation value of this building material is higher than that of other common materials generally used in farm construction because of the thickness of the soil brick wall. This high insulation value could prove to be very important in the South.

Unfortunately it is impossible to arrive at the actual cost of making a soil-rice hull ash stabilized brick. In most cases the soil will be locally available, but the rice hull ashes will be confined to the rice-producing areas, and transportation cost involved in obtaining these materials will vary according to location.

The one definite cost is that of the emulsified asphalt. It was obtained in 55-gallon drums at the nearest American Bitumels plant for 23½ cents per gallon, or 15½ cents per gallon if the purchaser brought his own drum and had it filled. For most small buildings at least 300 gallons would be used. Assuming that the builder purchases one drum of 55 gallons and then has this drum refilled, the average price would be approximately 17 cents. If he purchases the entire amount in drums, it would, of course, be 23½ cents. Our formula calls for 22 gallons per cubic yard. Using the above figures, the maximum cost would be $5.17 for each cubic yard of brick material and the minimum cost would be $3.74.

One wooden form designed to hold three bricks would cost approximately $1.00 for materials and would take about 30 minutes to make.

Sheet metal liners which are open top and bottom would cost approximately 40 cents each.

Some farmers will have mechanical mortar mixers. Those who do not, can mix by hand, or can rent or buy a mixer. New mixers will range in price from $150 to $500, depending on size.

It could be feasible to set up a community plant in a farming area where the cost of equipment could be pro-rated among the users.

Actual total costs, therefore, can not be estimated unless all conditions are known, including the number of bricks that are to be made.

The more bricks that are made with any one set of equipment, the lower the cost per brick. Under average conditions in the southern part of Louisiana, the cost would probably average $10 per cubic yard of soil used, and a cubic yard would make 120 bricks 12" x 8" x 4". This would mean a cost of slightly more than 8 cents per brick. A farmer having the equipment already and having easy access to the soil and rice hull ashes could make the bricks for as low as 5 cents each.

Weathering Test of Soilash Bricks

In 1953 a small test wall was erected so that a visual check could be made on the resistance of the Soilash brick to weather such as is experienced in Louisiana. The top of the wall was left completely unprotected and one-half of the side of the wall was given one coat of Bondex. The mortar used was a mixture of soil, rice hull ashes and emulsified asphalt with just enough water added to make it workable. At the time of writing this report, the bricks were in excellent condition with no signs of erosion or weathering on either the uncoated bricks or the ones coated with Bondex. However, shrinkage of the mortar as it dried caused some cracking at the joints, indicating further work should be done on more suitable bindings.

In June 1955 a small building was erected from Soilash bricks, and several types of cement mortars were used. The most satisfactory from the standpoint of economy, workability and appearance was that made from Magnolia Mortar Mix. The bricks were dipped in water before being put in place and the mortar then spread on the wet surface. A one-inch joint was used to compensate for the irregularity of the bricks and it was found to dry fast enough so that the laying could be continuous. When the soil-rice hull ash mortar was used in the test wall, only two courses could be laid at a time, since this mortar dried very slowly and the weight of the blocks caused considerable settling. As was done with the test wall, one-half of each wall was coated with Bondex. To date, no signs of weathering are apparent, indicating that no outside protection is necessary. However, the coating of white Bondex does improve the appearance considerably.

Protection Against Atomic Fallout

The possibility of attack by atomic weapons is something that must be considered. Tests conducted at L.S.U. by Dr. May L. Good on March 21, 1955, indicated that the Soilash material had the same shielding qualities as solid concrete of the same thickness. Since Soilash is much lighter than concrete and much less expensive, it may well be that a utility building constructed from this material could double for use as a shelter against radioactive fallout if such shelter were ever needed.

Insulation Qualities of Soilash

Adobe blocks have long been known as one of the best insulating mediums, mostly because of the extreme thickness of the walls in adobe constructions. It has not yet been possible to determine the exact 'K' value of Soilash material, but comparative tests indicate that it is as good as adobe and possibly slightly better. Since the density of Soilash is only 70 per cent that of adobe and the rice hull ashes have inherent insulating qualities themselves, it is fully expected that the exact 'K' value of Soilash will be low.

LOOKING INTO THE FUTURE

One of the most exciting paths in our years of research led to a potential use of rice hulls that may be the most significant of any yet known. It began when the chief chemist of a company manufacturing prilled ammonium nitrate fertilizer read the report issued by this department on Soilash bricks. At the present time this company is using diatomaceous earth as the conditioning agent for coating the ammonium prills thereby preventing caking of the fertilizer in storage and providing a free flowing product. Diatomaceous earth, calcined for this particular use, contains approximately 90 per cent silica, with the balance being mainly aluminum and iron oxides. After reading the L.S.U. report in which mention was made of the fact that calcined rice hulls would analyze approximately 95 per cent silica, with the balance being of various oxides, this chemist requested samples of rice hull ashes for experimentation. Some time later, a letter was received which stated in part . . . "The diatomaceous earth used is ground so that 90 per cent will pass a 325 mesh screen, has a moisture content of 2½ per cent or less as received and a bulk density of 10 to 12 pounds per cubic foot. A sample of the rice hull ashes you forwarded to us was first ground to a screen size of approximately 100 mesh and was then screened to remove the partially burned hulls. Moisture was found to be .95 per cent and bulk density 28 pounds per cubic foot. . . . Samples of ammonium nitrate were coated with the screened ash . . . however, there was some caking tendency."

On receiving this report, some rice hull ash was ground to a fineness where 90 per cent would pass a 325-mesh screen and shipped to this company for further tests. A verbal report received at a later date indicated that there was still some caking but not as much as in the first test. Unfortunately, the density of the finely ground rice hull ashes was too high, running in the neighborhood of 70 pounds per cubic foot. The immediate problem then is how to create a fine-particle-size ash at a low density, say 30 pounds per cubic foot or less. It was theorized that the minute cells of the ash structure were being destroyed by the fineness of the grinding and that other methods should be considered that might allow retention of cellular structure. Since it was known that in burning, the basic structure of the hull was retained but was reduced in size, the procedure previously used was reversed and the hull ground first to a fineness that would pass through a 200-mesh screen and then reduced to an ash, with the results being encouraging. It was then found that the calcinated particles would pass through a 250-mesh screen and the density was only 40 pounds per cubic foot. This was definitely a step in the right direction but not quite good enough.

If a processing method could be perfected, a huge market for rice hulls would be created immediately. One cooperating company would need 15 tons of rice hull ashes per day each day of the year. This would mean an annual requirement of 5,475 tons of ashes, which in turn means a potential use for 27,275 tons of hulls. Since there are several similar companies in the U.S. and each one would be a potential user, a large market for an otherwise useless waste would exist.

Because of the possibilities in this field with the resultant effect on the income of the rice producers, it was felt that others who were better equipped to develop means of processing the calcinated rice hulls should be approached. Therefore on February 1, 1956, Dr. A. M. Altschul, Head of the Oil Seed Division, Southern Utilization Research Branch, USDA, at New Orleans, Louisiana, was contacted. Dr. Altschul was very much interested in this problem and immediately assigned Dr. Ralph W. Planck to investigate and report on the situation. If Dr. Planck's report seems favorable, it is understood that this Laboratory will endeavor to perfect a method of processing the rice hulls so that the end result will be a usable substitute for the diatomaceous earth now being used.

APPENDIX

Flameproofing Rice Hulls for Use as a Loose Insulant

The treating solution consists of 60 per cent commercial boric acid and 40 per cent commercial borax dissolved in water. By experiment it was determined that 82 pounds (about 11 gallons) of water at 80° F. would dissolve 10.8 pounds of boric acid and 7.2 pounds of borax.

Steeping, or soaking of the dry hulls in the treating solution, was complete after four hours of complete immersion.

Draining, after removal of the hulls from the steeping tank, required different times, varying with the thickness of the pile of steeped hulls. Complete drainage saves treating solution, which can be used again. It also reduces the cost of subsequent drying of the hulls.

Drying was accomplished in the tests by exposure to air averaging 75° F. with relative humidity of about 80 per cent. It was found that when about 70 per cent of the solvent water had been evaporated the treated hulls would no longer stick together. At this stage they could be stored or put in use. Since the final moisture content of the hulls in storage or in use is determined by the condition of the air, it is best not to reduce solvent water content more than 80 per cent. This reduces the cost of drying and makes for better handling. After drying, the hulls are quite flame resistant and may be stored or shipped in bulk or in sacks. (The above extracted from a report on the "Use of Treated Rice Hulls as a Loose Insulant" by H. R. Bodemuller, dated February 20, 1946, the original of which is on file with the Department of Commerce and Industry of the State of Louisiana.

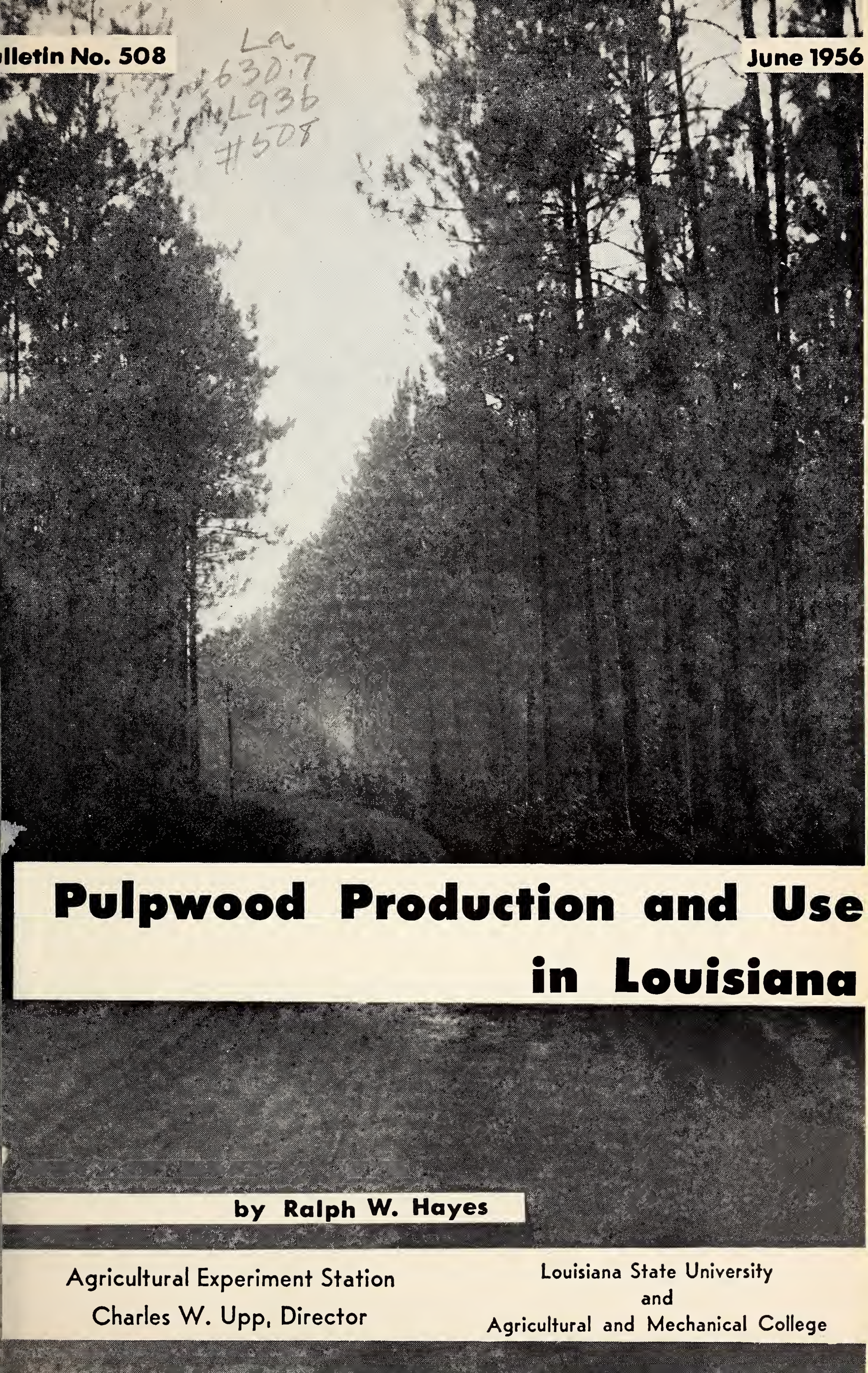
For those readers who wish to obtain more detail regarding the various uses for rice hulls, it is suggested that the following two publications be obtained:

1. *Refractory Insulators and Porous Media from Vegetable Sources,* by James D. Jones, Ontario Research Foundation, Toronto, Canada.
2. *The Industrial Utilization of Rice Hulls,* by Elbert C. Lathrop, USDA Northern Regional Research Laboratory, Peoria, Illinois.

lletin No. 508

June 1956

La
630.7
L93b
#508



Pulpwood Production and Use in Louisiana

by Ralph W. Hayes

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University
and
Agricultural and Mechanical College

TABLE OF CONTENTS

	Page
Introduction	3
History of Pulpwood Production in Louisiana	3
Current Pulp Production in Louisiana Mills	5
Economic Importance of the Pulp Industry in Louisiana	6
Comparison of Pulpwood and Lumber Production	9
Species and Sizes of Timber Cut for Pulpwood	10
Importance of Hardwoods for Pulpwood	10
Improvements in Pulpwood Utilization	11
Conservation Practices of Pulp Companies	15
Potential Pulpwood Production in Louisiana	15
Summary and Conclusions	22

ACKNOWLEDGEMENT

The author wishes to acknowledge the cooperation of the members of the faculty of the School of Forestry, and the members of the State Forester's local staff who assisted in the planning and development of this project.

Pulpwood Production and Use in Louisiana

Ralph W. Hayes, Forester*

Introduction

The decreasing output of pine lumber in Louisiana in recent years, accompanied by the increase in production of pulpwood from both softwood and hardwood, presents a problem in future forest policy which justifies this study.

In 1954, over twice as much pine was used as pulpwood as was cut into lumber. The percentage of the total pulpwood production coming from hardwood species has increased tenfold in the last eight years.

About 6 per cent of the pulpwood cut in the 38 states which produced pulpwood in 1954 came from the forests of Louisiana. Over 11 per cent of the workers in all manufacturing establishments in the state were employed in the pulpwood and paper industries. This production and employment has developed in less than 40 years, as the first pulpwood was cut in Louisiana in 1917.

Several new paper-producing companies have recently indicated an interest in establishing mills in Louisiana and have made some investigations regarding possible location and raw material supply. One of the plants presently operating in the state recently announced they were considering establishing a second plant and were investigating possible locations.

The anticipated increasing demand for pulpwood in the nation in the next 20 years will no doubt be concentrated in the South. Because of Louisiana's present rank in pulpwood production and the potential supply, the state should, and will be expected to, develop its pulpwood resources to supply at least its share of the South's raw material.

This study gives a brief history of the development of the pulp and paper industry in the state, the present status, and future possibilities. It is hoped that the information included will be of interest and value to forest managers in state work and private industry and be of some help in developing forest policies for future management practices for the forest lands of the state.

History of Pulpwood Production in Louisiana

The first commercial pulpwood produced in Louisiana was cut on the lands of the Great Southern Lumber Company of Bogalusa in 1917. This pulpwood was converted into paper by the new paper mill of the

---

*The pictures in this publication are Louisiana Forestry Photos.

Bogalusa Paper Company, a subsidiary of the Great Southern Lumber Company, which produced its first commercial sheet of paper early in January 1918.

The farsighted officials of the Great Southern Lumber Company, one of the largest sawmills in the world, realizing their sawtimber supply would be exhausted in some 20 years and that a new crop of sawlogs could not be grown in that time, decided to construct the pulp mill to provide a means of using some of their ordinary sawmill waste, and to provide a method of using smaller trees to be grown on their cut-over lands. The Bogalusa Paper Company operated successfully under these conditions until the sawmill cut out in 1938.

The Bogalusa Paper Company mill, and a large portion of the land owned by the Great Southern Lumber Company, were taken over by the Gaylord Container Corporation with headquarters at St. Louis, Missouri, when the lumber company cut out. The mill has been enlarged, additional types of production developed, and remanufacturing plants added. The corporation acquired considerable additional land acreage and has carried on extensive forest planting. The mill has been in continuous operation since 1918. In 1955, a merger of the Gaylord Container Corporation and Crown-Zellerbach Corporation of San Francisco took place, and the mill is now being operated as the Gaylord Division of the Crown-Zellerbach Corporation.

Following the completion and successful early operation of this first Louisiana mill, and realizing the extensive areas of young pine timber naturally established after the cutting of the original stand and the timber growing potential in many parts of the state, other companies constructed paper mills within the next ten years.

The second such plant was that of the International Paper Company at Bastrop, established in 1921. It is still owned and operated by the original company.

In 1924 the Brown Paper Company, Inc., built a mill at West Monroe. This plant was continuously operated by the original company until 1955, when it was acquired by the Olin-Mathieson Chemical Corporation. It is being operated as a part of the activities of this corporation.

The fourth mill to be built in the state was the second International Paper Company plant at Bastrop built in 1925. Both Bastrop mills have been continuously operated by the original company since they were established. The two Bastrop mills and their production are reported together in most reports of the industry.

The fifth mill in the state developed from an experimental plant built by the Industrial Lumber Company of Elizabeth in 1921 to manufacture paper from pulp processed from stumps left after logging. This operation never developed successfully, and was changed to a round wood mill in 1926, and was acquired by the Calcasieu Sulfate Paper

Company. In 1946, the name was changed to Calcasieu Paper Company, Inc. Plant production was increased to its present capacity in 1950. It has been in continuous operation since 1926.

In 1928 the sixth paper mill in the state was completed at Hodge, built by the Southern Advance Bag and Paper Company. It was continuously operated by the original company until early in 1955, when it was sold to Robert Gair Company, Inc., and is now known as the Southern Advance Division of that company.

The International Paper Company constructed its third mill in the state in 1938 at Springhill. It is one of the two largest in the state and has been operated continuously by the International Paper Company since its completion. This was the last large mill built in Louisiana, making a total of seven.

There are two other small pulp mills in the state making specialized paper products. They are: Bird & Son, Inc., of Shreveport, with a rated capacity of 60 tons of semi-chemical pulp in 24 hours, and the Flintkote Company of New Orleans, with a rated capacity of 60 tons of miscellaneous pulp in 24 hours. Neither of these two companies owns or operates any forest land. Bird & Son report all their pulpwood is purchased from Jones Timber Company of Shreveport, and Flintkote purchases its raw material from various pulpwood vendors.

Current Pulp Production in Louisiana Mills

Most of the pulp produced in the South and in Louisiana is manufactured by the sulfate process and marketed as kraft paper or manufactured into bags, boxes, etc. for the trades.

The sulfate process of pulp production, in addition to caustic soda (NaOH), uses some sodium sulfide (Na_2S) and small amounts of other relatively inactive compounds such as sodium carbonate and sodium sulfate in the cooking liquor. Southern yellow pines provide the majority of wood used by this process. The pulp usually produced is known as "kraft" pulp, is brownish in color, and is used for the manufacture of wrapping paper, bags, and other container products where strength is important. It can be bleached, but the process is expensive and although some southern plants bleach their product, the practice is not common at the present time.

The semi-chemical process of pulp production is extensively used in pulping hardwoods. Increased yields are secured by regulating the cooking procedure, i.e., temperature, concentration of chemicals, and time of cooking, so as to prevent the solution of some of the cellulose and lignin. Following a mild cooking, the chips can be broken into pulp by mechanical means. By this means, yields can be considerably increased. The principal use is for the production of corrugated board. This process offers excellent opportunities for an increase in the utilization of the South's low-grade hardwoods.

Groundwood, or mechanical pulp, is produced by forcing peeled wood laterally against a revolving grindstone, reducing the wood to a fibrous mass which is screened and thickened and converted into pulp products. The yield of groundwood pulp is high, often as much as 90 per cent of the dry weight of the wood. It has low strength and is used largely in cheaper grades of paper and in boards, and as an absorbent for explosives in dynamite.

The processes used and the rated capacity of the Louisiana mills are shown in the following table.[1]

		24-hour pulp capacity (tons)			
Name	Mill location	Sulfate	Semi-chemical	Ground wood	Miscellaneous
Gaylord Division of Crown-Zellerbach Corp.	Bogalusa	1040	135		
International Paper Co.	Bastrop	540	525	60	
Brown Paper Mills Division of Olin-Mathieson Chemical Corporation	West Monroe	550			
Southern Advance Division of Robert Gair Company, Inc.	Hodge	325			
International Paper Company	Springhill	1560			
Calcasieu Paper Company	Elizabeth	200			
Bird & Son, Inc.	Shreveport		60		
Flintkote Company	New Orleans				60

This shows total pulp producing capacity of the mills in Louisiana, on a 24-hour day basis, as 5,055 tons, consisting of 4,215 tons of sulfate pulp, 720 tons of semi-chemical pulp, 60 tons of groundwood pulp, and 60 tons of miscellaneous pulp.

Economic Importance of the Pulp Industry in Louisiana

Louisiana's rank in the industry, as of 1954, is shown by the following statements.[2]

In the capacity for production of sulfate pulp, Louisiana ranked third in the South and the nation, exceeded only by Georgia and Florida in the order given.

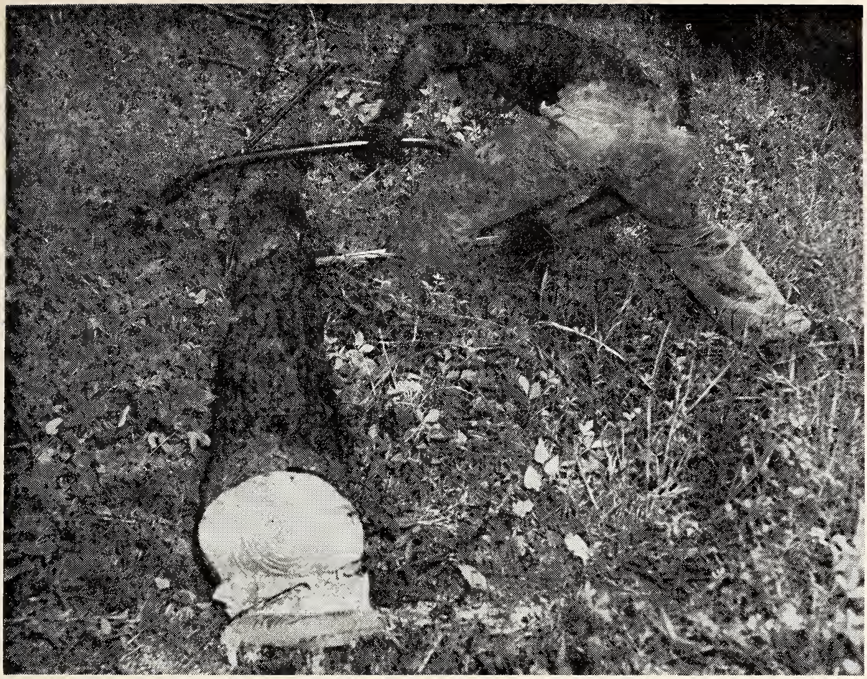
The total rated capacity of the sulfate pulp mills in the 11 southern states in 1954 was 32,842 tons per day. Louisiana had about 15.5 per cent of this total producing capacity.

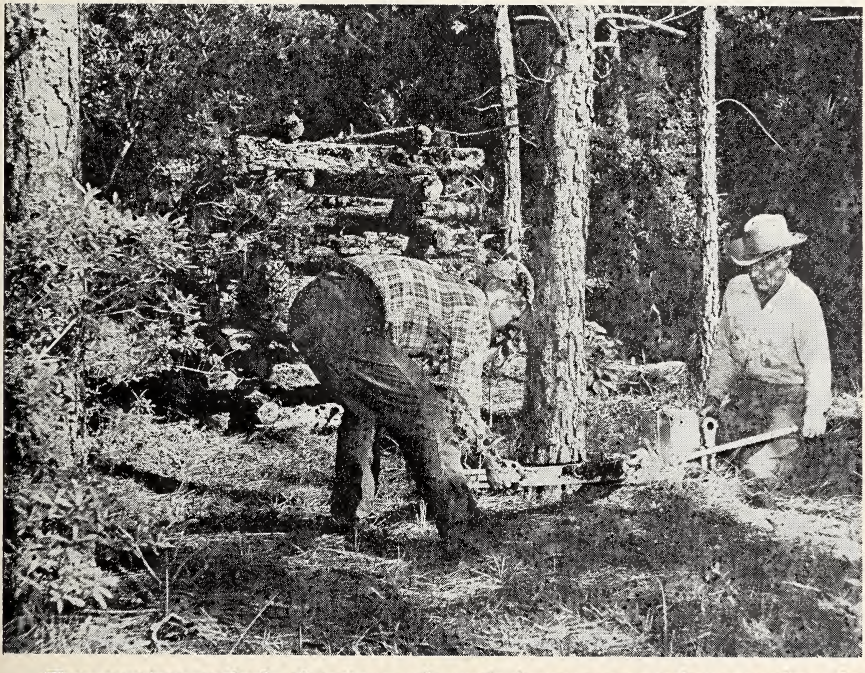
The total national sulfate pulp production capacity was 61,798 tons daily. Louisiana had 8.18 per cent of this capacity from all such mills in the 33 states where pulp is produced.

---

[1] From "Wood Pulp Mills in the United States," by U.S. Forest Service, Division of Forest Economics. April 1955.

[2] Taken from "Facts About the Nation's Pulp, Paper and Paper Board Industry," 1955 edition, and other pulpwood information published by American Forest Products Industries, Inc., in cooperation with American Paper and Pulp Association.





Two common methods of cutting pulpwood. A power saw is being used in the bottom photo. Cutting is being done by hand labor in the top picture.

Considering all pulp mills in the nation and including all types of pulp produced, Louisiana ranks fourth as a state in total production capacity, exceeded only by Washington, Georgia, and Florida in the order given.

Returns from a questionnaire sent to the pulpwood producers and paper mills of the state indicate approximately the following raw material costs, production costs, and economic importance of the industry to the state.

The cut of pine pulpwood in the state in 1954 was about 1,260,000 cords. Based on available figures, the approximate cost of producing this pulpwood and delivering it to the mills was about $18.15 per cord. This cost included payment for stumpage or credit allowed for cutting from company-owned lands, cutting, woods hauling to concentration point, freight, insurance, constractors' fees—in fact the cost of rough pulpwood ready for processing. Hardwood pulpwood costs were figured the same as for pine, except for the difference in stumpage cost. Hardwood pulpwood stumpage was estimated at an average of $1.00 per cord, while pine stumpage was estimated at $3.25 per cord, so the delivered cost of hardwood pulpwood was about $15.90 per cord. The hardwood pulpwood cut in 1954 was approximately 240,000 cords. These costs total $26,685,000, an amount largely paid to labor for pulpwood production.

The annual cost of operation of the paper producing plants in the state is roughly estimated at $60,000,000. State and local taxes, including tax on timber land paid in 1954, are estimated at $6,000,000. Thus, an estimated $92,685,000 was spent in the state by this industry in 1954. Incidental items not considered would indicate the operating pulpwood and paper industry to be at least a hundred million dollar industry.

The employment by the plants is estimated at from 12,000 to 13,000 persons, with some 4,000 more classified as employed in wood procurement, or a total of 16,000 to 17,000 employees. This would indicate a total of from 64,000 to 68,000 persons depending on the over-all payroll of the industry.

This estimate does not take into consideration the value of the forest land in the state owned by the pulp mills. The forest area owned or leased by the pulp mills of the state is approximately 2,000,000 acres. The value of these lands depends on many things and cannot be definitely stated. It is estimated that these lands are worth at least $50,000,000 on the basis of future production. The value of the plants is unknown, but taking the forest land, the plants, and annual expenses for raw material and operation into account, the pulp and paper industry of the state represents about a $250,000,000 industry. This would be one of the largest industries in the state, if not actually the largest.

Comparison of Pulpwood and Lumber Production in Louisiana

In 1954 the Louisiana Forestry Commission reported 308,500,000 board feet of pine logs were cut in the state for lumber production under the regular severance tax law. In addition, 46,500,000 board feet of timber was cut from timber conservation contract lands. Estimating that, because of the character and location of the contract lands, three-fourths of this was pine and one-fourth hardwood, the total cut of pine for lumber was approximately 343,000,000 board feet. In the manufacture of lumber from trees as they grow in the forest, one cubic foot of solid wood will produce from five to eight board feet of lumber. Thus on the basis of 6.5 as a factor for converting board feet to cubic feet, this pine lumber cut represented approximately 53,000,000 cubic feet of live standing pine timber.

The 1954 pulpwood cut in the state, as reported by the Louisiana Forestry Commission, was approximately 1,500,000 cords. United States Forest Survey Release No. 76 reported about the same cut. About 84 per cent of this pulpwood was pine, the other 16 per cent hardwood. This indicates a total of 1,260,000 cords of pine pulpwood and 240,000 cords of hardwood pulpwood.

The solid wood (cubic foot) content of a cord of pulpwood varies somewhat, depending on such factors as the size of sticks, roughness, bark thickness, length, etc. For the purpose of comparison, we will assume the

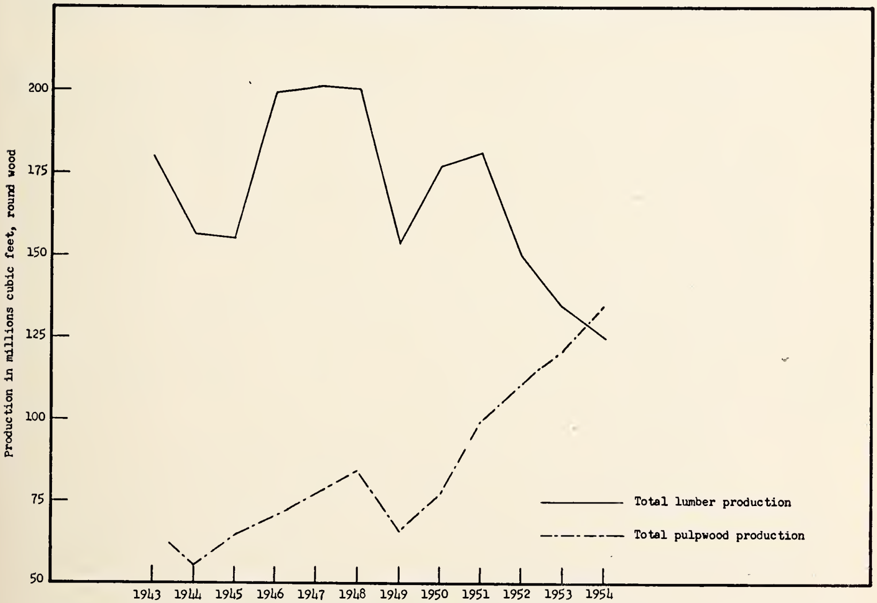


Figure 1.—Lumber and pulpwood production in Louisiana, in cubic feet, 1943 to 1954. (From Louisiana Forestry Commission releases, using conversion factors in report.)

average cord contains approximately 90 cubic feet of solid wood. Multiplying the 1,260,000 cords of pine pulpwood produced by 90, we get the total of 113,400,000 cubic feet of pine timber converted to pulpwood in 1954. Comparing this volume to the 53,000,000 cubic feet of pine cut into lumber, we see that more than twice as much pine from Louisiana's forests was used for pulpwood in 1954 as was used for lumber.

If we make the same comparisons for hardwood lumber and pulpwood produced in 1954, we find the following facts: Approximately 475,000,000 board feet of timber was cut and converted into lumber. On the basis of the same conversion factor used above, this would be about 73,000,000 cubic feet. The 240,000 cords of pulpwood would equal approximately 21,600,000 cubic feet. This shows that more than three times as much hardwood timber was used for lumber as for pulpwood. The trend toward increased use of Louisiana's timber for pulpwood has been developing for some time, culminating for the time being at least, in the relationship shown above for 1954.

Figure 1 shows the relation between lumber and pulpwood production in Louisiana for specified years.

Species and Sizes of Timber Cut for Pulpwood

Because of its wide distribution in Louisiana, loblolly pine is the softwood most extensively used for pulpwood production, although all of the southern pines are used when they are found naturally or have been established by reforestation. All southern pines generally produce good quality pulp by the extensively used sulfate process.

The 16 per cent of the state's pulpwood production derived from hardwoods in 1954 came largely from the species of gum found extensively in the state: sweet gum, tupelo gum, and black gum. These woods, together with cottonwood, willow, soft maple, yellow poplar, and sweet bay, are known as soft-textured hardwoods, all of which are quite acceptable for pulpwood where found. The hard-textured hardwoods such as the oaks, hickories, elm, ash, birch, etc. are not as extensively used at the present time, but research and experimental work are extending the use of hardwoods for pulpwood, so that most of the species found in the state are used to some extent. The future of our hardwoods for pulp production depends on many factors, but it is almost certain that their use for this purpose will increase.

Importance of Hardwoods for Pulpwood

The trend toward more hardwood pulpwood production in the state has been definite and positive. In 1946, only about 1.5 per cent of the pulpwood cut in Louisiana was from hardwoods, the percentage increasing to 16 per cent in 1954. This trend, which was gradual and regular, will probably continue, as the potential additional raw material for increasing pulpwood needs, especially for the next few years, is greater than in pine. If this rate of increase continues for the next five

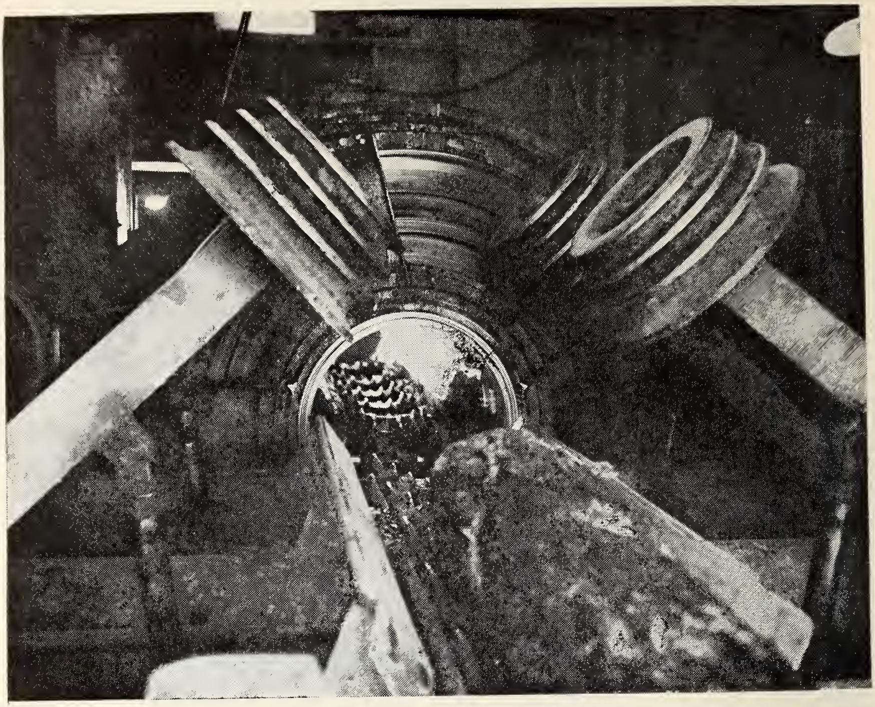
Loading pulpwood onto truck in woods.

years, 25 per cent of the pulpwood produced in the state will be from hardwoods.

A large percentage of the pulpwood produced in the state comes from trees 6 inches to 15 inches in diameter breast high, or 4½ feet above ground level. Some 5-inch trees may be cut in thinning a young stand to improve spacing and reduce competition, but trees this small are not usually considered economically desirable for pulpwood production. Trees up to 20 inches in diameter, occasionally larger, are sometimes cut for pulpwood, and the bolts split before they go to the chipper. The cutting policy in reference to size depends on several factors, such as ownership, age of the stand, density, and quality of site. If the land is owned by the operating company, they may be interested primarily in supplying their plant, if possible, from their own lands and may be ready to cut trees up to 20 inches in diameter to do it, rather than sell the larger trees to a sawmill for lumber production and buy pulpwood in smaller-sized trees from other land owners.

Improvements in Pulpwood Utilization

There are three sources of pulpwood supply: (1) standing timber, the chief source at the present time; (2) tops, broken logs, or other woods waste; and (3) chippable sawmill waste.



Equipment used in debarking saw logs so that slabs and edgings can be salvaged for manufacture of pulp. This is a rather recent development that is growing in importance in the state's pulp industry.

As previously stated, the main source of pulpwood in most localities today is found in standing trees cut into round pulpwood bolts. The industry as a whole, and in cooperation with sawmills and other timber using industries, is continuously searching for ways of more completely utilizing the wood produced on the forest land acreage harvested each year. The residue left in the woods after the harvesting of such primary products as sawlogs, poles, piling, and crossties is a potential source of additional pulpwood.

Several different types of small, portable barkers and chippers are being developed which can be taken to the woods where they can be used to produce usable chips from the above type of woods residue without hauling it to the mill. Several types of chip conveyors have been produced for use with this machinery, in addition to railroad cars, that may be used for hauling chips from the producing unit in the woods to the mill. This type of pulp chip production is not extensively used in Louisiana today but will be used to a greater extent in the future.

Chippable sawmill waste has the greatest potentiality for increasing the production of raw material for paper manufacture. It is being worked up in two ways.

During the past few years several different machines have been developed for removing the bark from sawlogs before milling, making it possible to use the slabs and edgings from these debarked logs to produce chips for making pulp. Such bark-free slabs and edgings can be sold to pulpmills or put through chippers where produced and the chips sold to pulpmills. This system has been extensively used in the West in recent years where sawmill waste is greater than in the South. One un-

Debarked log emerging from debarker. Slabs and edgings from this log will go to chipper. Chips will be used in manufacture of pulp.

designated papermill in the Pacific Northwest reportedly[3] manufactured 250 tons of pulp a day from chips produced from other plants' milling residue. Chips from such residue materials in the West alone are producing the equivalent of 1,000,000 cords of pulpwood annually.

Log barking equipment was not used in the sawmills of Louisiana to any appreciable extent until very recently. The lastest available information[4] gives the pine chip production at the sawmills having log barking equipment as 2,800,000 pounds per week. This publication also gives the conversion factor to change the weight to cord equivalent as 5,000 pounds. This would give a production of 560 cords per week, or 29,120 cords per year, from only five sawmills. It is almost certain that several other mills will install log peeling machinery, and the chip production from this source should reach 100,000 cords or more per year in the next few years.

The potential chippable waste problem was the subject of a study made by the Southern Forest Experiment Station in 1950.[5] In this study Mr. Carpenter found that the average chippable waste resulting from the sawing of 1,000 board feet of lumber was equal to about one-half cord of pulpwood. Complete utilization of chippable waste at sawmills will never be realized because the small sawmills could not afford, nor would they be justified in attempting to use, the necessary equipment. But the larger mills are justified, from both the financial and utilization standpoints, in installing debarking equipment.

A possible solution to the slab and edgings waste at the small, portable and semi-portable sawmills is the development of different types of slab debarkers which have been used with varying degrees of success in the North and West, and have been introduced and used to a limited extent in the Southeast and South. This type of debarking equipment can be used at the pulp mill where slabs could be secured from sawmills within a reasonable hauling distance, taken to the pulp mill, bark removed, and put through the regular chippers at the mill. Any slabs thus available and used would reduce the round wood requirement of the mill. This type of chip production is in use at some mills now and no doubt will increase in the future.

This use of chips from these sawmill wastes, and no doubt chips from present woods waste, can do one of two things, and probably both. First, it would definitely reduce the amount of round wood required for the pulpmills of the state. Second, if fully developed, together with improved stocking and increased production of round wood from the state's forest acreage, it would provide raw material for additional pulpmills in the state.

---

[3] "Facts About the Nation's Pulp, Paper and Paper Board Industry," 1955 edition. American Forest Products Industries, Inc., Washington, D. C.

[4] "Pulp Production," January 1956. Hatton Brown & Co., Inc., Montgomery, Ala.

[5] "Chippable Waste in Southern Pine Sawmills," by R. D. Carpenter. Occasional Paper No. 115, published by the Southern Forest Experiment Station, New Orleans, Louisiana.

Conservation Practices of Pulp Companies

Pulp companies practice good forestry on their own lands, marking the timber to be cut and conserving a definite portion of the stand for future growth, seed production, and later cutting. Technical foresters are used to supervise, and in some cases, actually do the marking work.

This same type of good cutting practice, or conservation, is practiced where pulpwood is purchased from private owners if the owner will allow his timber to be cut in this way. In some instances, a land owner may demand that his area be clear cut, planning to use it for pasture or farming. In every instance the pulp company would probably prefer to cut properly so that they may have the opportunity of returning in five or ten years for another cut.

This type of work is under the direction of technical foresters, commonly known as conservation foresters. They have been a very definite help to private land owners and, by improving the forest practice on these lands, have built up the prestige of the pulp companies with these owners. Their job is largely one of public relations and has really paid off in service and public good will.

Potential Pulpwood Production in Louisiana

Pulpwood production in Louisiana has fluctuated with the general business cycles since 1917, but the trend has been upward, particularly since 1949, as shown in previous graphs. In each of the years 1951 to 1954 inclusive more than one million cords were produced, and the same trend is expected to continue in the future. The Stanford Report[6] predicts a gradual but continuous increase in pulpwood requirements from the South and the nation in the twenty-three years, 1952-1975. This increase in the national use of softwood is predicted to be about 33 1/3 per cent, while the increased use in the South is figured to be about 50 per cent. The change in the use of hardwood for pulp presents a more startling picture. For the nation, the use of hardwoods for pulpwood is predicted to increase about 210 per cent, while in the South the increase is predicted to be nearly 300 per cent. Because Louisiana is one of the chief pulpwood producing states of the South, we certainly should develop our production to meet the expected need, and, if we hope for more pulpmills, produce much more than these increased percentages indicate.

Another very important source of additional raw material for pulpwood as well as sawlogs on the lands of the state classified as commercial forest land could be realized through improvement of stocking, thus growing more trees per acre.

---

[6] "America's Demand for Wood, 1929-1975." A report by Stanford Research Institute, Stanford, California, to Weyerhaeuser Timber Company, Tacoma, Washington, 1954.

Just about one-half of our 16,000,000 acres of commercial forest land is classified as well stocked. Forest Survey Release No. 75[7] considered stocking as "the extent to which growing space is effectively utilized by present or potential growing stock trees of commercial species." For well stocked stands, 70 per cent or more of the growing space was utilized, an average of 85 per cent. About one-fourth of the area is classified as medium stocked, ranging from 40 to 69 per cent of full stocking, or an average of 55 per cent. Just over one-eighth of the area is classified as poorly stocked, ranging from 10 to 39 per cent, or an average of 25 per cent. A little less than one-eighth of the area is classified as non-stocked, or under 10 per cent stocked, an average of 5 per cent. These figures definitely prove that we are not growing nearly the possible volume of wood that could be grown in the state.

Forest Survey Release No. 75 divided the state into five regions for study and report purposes. These regions are shown on the outline map of the state (Figure 2 on Page 17).

The rate of growth of our forests varies on different soils, but studies of well stocked natural stands and planted areas show a growth of from 50 to 100 cubic feet per acre per year. If we use the minimum growing figure, and consider an average of 30 years desirable to grow trees from seedlings to desirable size for use, this would give us growing stock volume of 1,500 cubic feet per acre. On this basis, the future productivity of our forest lands is impressive.

In the Southeast region the average growing stock per acre on 1,257,300 acres of commercial softwood type lands in 608 cubic feet, or a total of 764,500,000 cubic feet. If the growing stock were increased to 1,500 cubic feet per acre, the total volume would be about two and one-half times the present amount, or 1,911,000,000 cubic feet, an increase of 1,146,500,000 cubic feet. The present hardwood volume per acre is about 800 cubic feet on 745,500 acres, or total of about 600,010,000 cubic feet. Increasing this to 1,500 cubic feet per acre would mean about 1,118,250,000 cubic feet, an increase of 518,250,000 cubic feet. This would make a total increase in growing stock for the region of 1,664,500,000 cubic feet.

In the Southwest region we find an average of only 400 cubic feet of growing stock per acre on its 3,525,300 acres of softwood type forest, or a total of about 1,400,000,000 cubic feet. If the growing stock were increased to 1,500 cubic feet per acre, total volume would amount to 4,550,000,000 cubic feet, an increase of 3,150,000,000 cubic feet. This region has an average of 1,120 cubic feet of hardwood per acre on about 1,350,000 acres of hardwood type, or a total of 1,512,000,000 cubic feet.

---

[7] "Forests of Louisiana, 1953-1954." Southern Forest Experiment Station, New Orleans, Louisiana. April 1955.

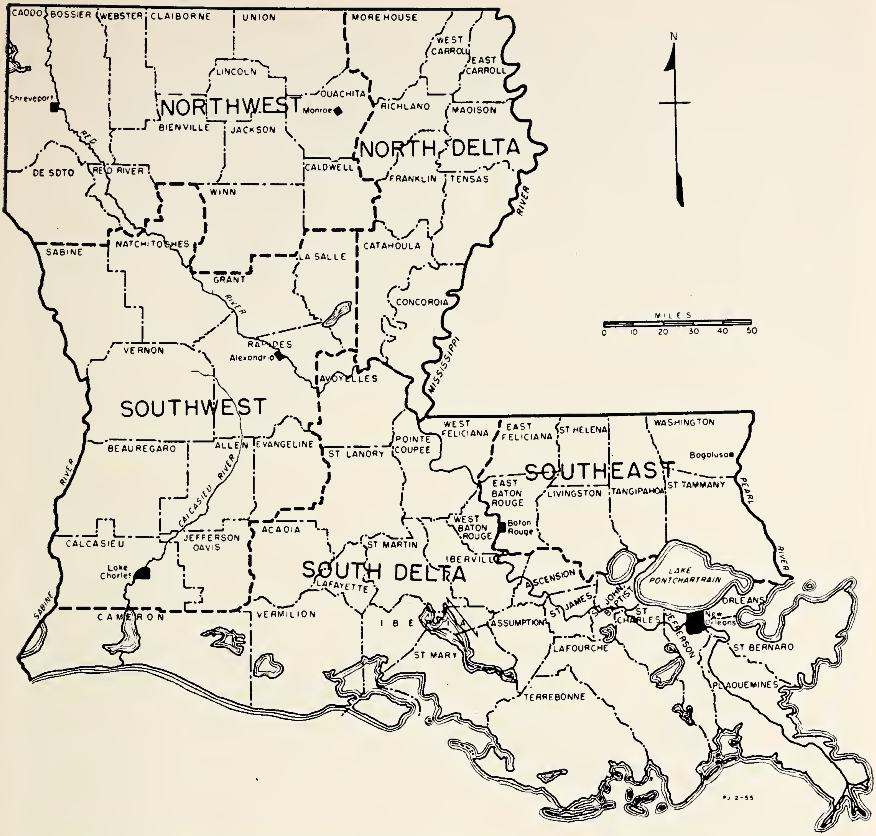


Figure 2.—Forest Survey regions in Louisiana. **(From Forest Survey Release 75, April 1955.)**

Increasing the growing stock of hardwood to 1,500 cubic feet per acre would bring the total up to about 2,050,000,000 cubic feet, or an increase of 538,000,000 cubic feet. The total growing stock increase for the region would be an astounding 3,700,000,000 cubic feet.

In the Northwest region, we find an average of nearly 600 cubic feet per acre on 2,785,400 acres of softwood type forest, or a total of about 1,600,000,000 cubic feet. If increased to 1,500 cubic feet per acre, this volume would be about 4,000,000,000 cubic feet, an increase of 2,400,000,000 cubic feet. Here again the hardwood volume is large, about 1,100 cubic feet per acre on 1,384,400 acres of hardwood type land, a total of about 1,524,000,000 cubic feet. Increasing this to 1,500 cubic feet per acre would bring the total to about 2,060,000,000 cubic feet, an increase of 530,000,000 cubic feet, or a total increase for the region of nearly 3,000,000,000 cubic feet.

Loading pulpwood on railroad car from truck.

In the North Delta region, there are about 600 cubic feet per acre on 168,300 acres of softwood type area, or a total of 108,800,000 cubic feet. If the volume on this area were increased to 1,500 cubic feet per acre, the softwood type area would have a volume of 272,000,000 cubic feet, an increase of 163,200,000 cubic feet. The hardwood type area is large, 2,003,000 acres, and has a growing stock volume of 850 cubic feet per acre, a total of 1,702,100,000 cubic feet. Increasing the volume to 1,500 cubic feet per acre would result in a volume of 3,004,100,000 cubic feet, or an increase of 1,302,000,000 cubic feet. This would be an increase of growing stock in the region of about 1,465,200,000 cubic feet.

The South Delta region shows an unusual condition, in that the softwood type area of 97,700 acres now has a growing stock volume of 4,600 cubic feet per acre. This volume is mostly sawtimber-sized pine. The total volume is about 439,200,000 cubic feet, and of course is much greater than 1,500 cubic feet per acre, and no increase in volume should be expected. The hardwood type area is 2,721,900 acres and the average growing stock volume is about 900 cubic feet per acre, a total of about 2,466,100,000 cubic feet. Increasing this to 1,500 cubic feet per acre would produce about 4,110,100,000 cubic feet, an increase of 1,644,000,000 cubic feet for the region, all in hardwood.

These calculations show a present growing stock volume in the state, both softwood and hardwood, of over 12 billion cubic feet. This volume is supporting our present sawmill and pulpwood operations and producing a surplus above use. Increasing the growing stock as suggested above would allow for continuously increasing use as increased volume was developed by natural regeneration, direct seeding, or planting of nursery stock and would provide a growing stock volume of over 23 billion cubic feet at the end of a 30-year period. This volume of growing stock should be maintained or increased, when once reached, by cutting only the annual growth. The annual growth for the state given in Survey Release No. 75, as a result of careful on-the-ground study and measurements, was 716 million cubic feet. This growth was based on 12,114,000,000 cubic feet of growing stock and amounts to about 6 per cent volume increase per year.

The future growth rate should be at least equal to the present rate. The possible future growing stock has been figured to be 23,000,000,000 cubic feet. Using our present growth rate of 6 per cent on this growing stock gives an annual growth of 1,380,000,000 cubic feet, or almost twice as much as at present. This growth would be available for lumber, pulpwood, and other forest products production.

As we build up our growing stock and annual growth, additional opportunities for use must be considered. Improvement and refinement in the lumber manufacturing methods, together with better merchandising of the product, are desirable. As the production of lumber in the West decreases as the cutting of virgin timber progresses, more southern pine should be needed for lumber. These conditions could justify two or three times the volume of standing timber for lumber and allied products production as was used in 1954. This could mean more sawmills or similar plants or greater production from those now found in the state. This could require one-fourth or more of the additional available volume.

Probably most of the additional volume beyond that required for additional sawmill needs will be used for the production of paper and

Scene at one of Louisiana's pulp mills. Pulpwood from the stacks is thrown onto the conveyor shown in center foreground which carries it to the mill.

paper products or be developed into wood fiber production. Many people think there will be much greater use of wood fiber in the future than at present, and such use should be provided for. There would be sufficient volume by the end of the development period for several new plants of this nature, possibly six to eight 500- to 1,000-ton plants. It would not be necessary to wait to the end of the period to establish all of them; they could be built as the available timber supply increased.

Provisions should be made to use both pine and hardwood, either in separate plants or in combination plants.

We are all interested in the financial feasibility of growing pulpwood as a crop. About 15,200,000 acres of state forest land are in private ownership, with about 3,200,000 acres in farm forest classification, leaving 12,000,000 acres in private non-farm ownership. Probably about one-half of this acreage needs some degree of planting or natural increase in stocking, and all of it needs protection. What is the incentive to develop these lands as property used for growth of forest products? What is the probable cost and possible returns from such development? Let's assume some figures (as nearly those that are applicable today as possible) and work out the problem, using a per-acre basis to eliminate the use of large figures.

Let's assume that much of this area has been owned by the present owners for several years or recently changed owners by mergers or consolidation. Some of it has been held and taxes paid to retain mineral rights, with little or no income. Present land market values vary widely, depending on several factors. For the purpose of this calculation, we will assume a land market value of $20 per acre and a going rate of interest of 4 per cent for long time, reasonably safe loans which we will apply as compound interest over the time necessary to carry a planted stand to harvest age, here considered to be 30 years. The interest on this land value at 4 per cent for 30 years would be $44.87.

Complete planting or seeding will cost approximately $10 per acre. It should, and probably will, be less as improved planting techniques are developed. Complete planting at this cost, again carried at 4 per cent interest for 30 years, would amount to $32.43. Partial planting would be proportionately less.

Taxes and protection must be provided for. These two items will amount to about 20 cents per acre per year. This cost at the end of 30 years will amount to $11.22.

Some supervision should be considered, and an average cost of 10 cents per acre per year seems reasonable. This carried for 30 years would accumulate to $5.60. The total cost, at 4 per cent compound interest, would amount to $94.12. Of this amount, $75.12 would represent interest on land value and production costs, leaving an actual cash cost of only $19 per acre for the production of a 30-year-old stand of timber.

A thinning should be possible in a fully stocked stand at 20 years of age, yielding about 4 cords of pulpwood per acre, worth $16.00. This would reduce the cash cost of the crop at 30 years of age to $3.00 per acre.

Our final crop at 30 years of age should be approximately 25 cords of pulpwood, worth an estimated $4.00 per cord, a total of at least $100, an income over actual cash cost of about $97 per acre in 30 years.

This calculation indicates the economic feasibility of growing timber on presently non-productive forest lands and putting Louisiana back into its proper place in the nation's timber production.

Summary and Conclusions

The pulpwood and pulp products industry is one of the most important in the state and is destined for increasing importance in the future.

Hardwood will be increasingly important in pulpwood production in Louisiana in the future. In 1946 only 1.5 per cent of the state's pulpwood output was from hardwood. In eight years, this increased to 16 per cent and probably will increase to 25 per cent or more in the next five years, and to a larger per cent in the years to come.

The commercial forest area of the state is capable of producing at least twice as much timber volume as at present if increased protection is provided and present understocked and non-stocked areas are brought into production by natural reseeding in some cases and by planting of nursery stock or direct seeding in others.

Additional pulp mills are definitely possible and desirable. With a growth in 1954 of twice the cut, and expected progressive increase in growing stock in the future, some expansion is possible in the next five years, with greater development to follow.

The use of chips from slabs and edgings from debarked logs at sawmills will be a definite and important contribution to pulp production in the future, and will reduce the round wood requirement.

Woods waste will be increasingly utilized through the use of movable debarking and chipping equipment in the production of chips for paper making, again reducing the round wood requirement of the pulp mills.

Utilization and conservation practices by the present pulp mills are improving continuously, and this improvement will continue.

The possibility and soundness of a policy of clear cutting a stand when it reaches pulpwood size and planting to produce the next crop deserves careful consideration by small land owners, possibly even by the large owners.

Forest Survey Release No. 75 indicates the need for timber stand improvement work on a large acreage of pine sites in the state, and also the removal of cull and undesirable hardwoods on hardwood sites. Species of hardwood which have not been used for pulpwood in the past are now being used in increasing amounts and it is possible that some of the desirable removal could be done at little or no cost if these trees were used for pulpwood.

In early lumbering days, Louisiana was one of the most important producing states in the nation. The concept of the use of forest raw material has undergone a change, as have the economic conditions in the state. The combination of lumber and pulpwood production offers an opportunity for integrated use of the products of our forests which will make it possible and profitable for Louisiana to develop her forest lands and again become one of the outstanding forestry states of the nation.

Bulletin No. 509

June 1956

La
630.7
L93b
#509

WINTER PASTURE STUDIES in Southwest Louisiana

by DAVID E. BLACK and R. K. WALKER

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University
and
Agricultural and Mechanical College

Winter Pasture Studies in Southwest Louisiana

David E. Black and R. K. Walker

INTRODUCTION

The seven major rice producing parishes in southwest Louisiana produce 89 per cent of the rice and 24 per cent of the beef cattle on 15 per cent of the cultivatable land in the state. The relatively high concentration of beef cattle in this area is due to the following factors:

1. A mild winter climate.
2. Rotation systems that provide a large acreage of native pasture.
3. Noxious weeds in rice are controlled to some extent by moderate to heavy grazing.
4. A large quantity of rice straw is available for hay.
5. Second-growth rice following harvest provides excellent grazing during September, October, and November.
6. Improved pastures and supplementary pastures can be established to provide year-round grazing.

Most of these factors show that rice and beef cattle enterprises benefit each other instead of being competitive.

Prior to 1945, cattle were wintered largely on huge rice straw haystacks that were specially constructed during the rice threshing operation. However, because of the switch to self-propelled combines which eliminated the traditional haystacks, a serious problem of providing winter feed was encountered. Earlier studies (1, 2) showed that year-round grazing could be profitably provided through improved pastures supplemented with winter pastures.

The purpose of these studies was to determine the value of several winter grazing crops and different methods and dates of seeding.

COMPARISON OF WHEAT, OATS, RYE GRASS, AND FESCUE FOR WINTER GRAZING

Experimental Procedure

An experiment was established in the fall of 1950 on Crowley silt loam soil. Four different pasture seed treatments were used. Each treatment was established on plots of four acres in size and was replicated twice. The pasture seedings were: (1) Southland oats, three bushels per acre; (2) rye grass, 25 pounds per acre; (3) fescue, 20 pounds per acre, and Crimson clover, 10 pounds per acre; and (4) fescue, 20 pounds per

---

COVER PICTURE—Oats that were seeded in rice stubble for grain production. Picture was taken January 25.

acre, and Alsike clover, 5 pounds per acre. All pastures were fertilized with 400 pounds of 3-12-12 fertilizer per acre at planting and topdressed with 32 pounds of nitrogen per acre on March 15, 1951. Since neither crimson clover nor Alsike clover made a satisfactory growth during the winter of 1950-51, wheat was substituted in the fescue-crimson clover pasture for 1951-52. Thus for the 1951-52 and 1952-53 seasons, the treatments were as follows: (1) Southland oats, (2) rye grass, (3) Atlas 66 wheat, (4) fescue. Three hundred pounds of 8-8-8 fertilizer per acre was used as topdressing in the fall and 30 pounds of nitrogen in the spring of the last two years.

Grazing was begun on these pastures when the forage was five to six inches tall, and the cattle were kept on these pastures continuously until about May 1. The number of cattle on each pasture was regulated according to the amount of forage produced, and cattle weights were recorded every 30 days. During the seasons of 1951-52 and 1952-53 the cattle were removed from one replication of the oat and wheat pasture on February 15 so that grain yields following pasturing could be obtained.

Experimental Results

The grazing data for the three winter seasons are presented in Table 1 and Figure 1. The oat pasture furnished the greatest carrying capacity and produced enough forage for grazing approximately 30 days earlier than either of the other three pastures. The oats produced an average of 185 pounds of beef per acre as compared to 167 for wheat, 145 for rye grass, and 67 for fescue. The total number of days of grazing per winter season from each of the pastures did not vary appreciably; however, the oats and wheat produced more forage earlier in the season, at a time when it is needed most. The average beef production per acre for each month during the growing season is shown in Figure 1. Fescue in this experi-

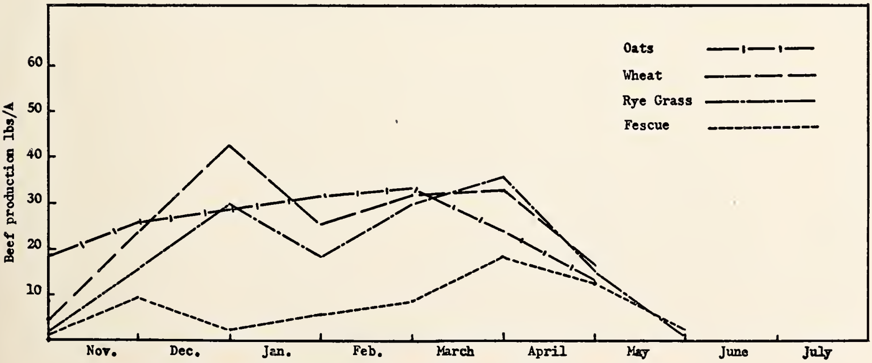


Figure 1. Average beef production per month on various winter pastures, 1950-53.

FIGURE 1.—Average beef production per month on various winter pastures, 1950-53.

TABLE 1.—Summary of grazing data from the winter grazing experiment, 1950-1953

Type of Pasture	Days grazing per year				Av. No. animal units /A*				Beef production (lbs./A.)				Grain yield (Bu. /A**)	
	1950	1951	1952	Average	1950	1951	1952	Average	1950	1951	1952	Average	1951	1952
Oats	66	200	134	133	1.13	0.43	0.62	0.72	153	216	188	185	22	7
Wheat	..	172	106	139	...	0.49	0.55	0.52	...	211	124	167	6	13
Rye grass	80	203	106	129	0.80	0.36	0.33	0.50	164	182	91	145	...	..
Fescue	74	214	162	150	0.70	0.34	0.28	0.44	99	56	48	67	..	..
Fescue & Crimson clover	74	...	...	...	0.73	...	...	...	115	..	..	..	..	..

* Animal units equal 1,000 pounds of animal.

**Grain yields were measured after grazing was discontinued February 15 on one replication.

ment, as in other experiments, consistently produced low yields and is not considered adapted to the rice area of southwest Louisiana.

Discussion

Oats were somewhat superior to wheat, rye grass, and fescue for winter pastures because of earlier initial grazing and also higher beef production per acre. It was very evident that these crops will not be successful for winter grazing on the soils of southwest Louisiana unless extra care is taken to provide good surface drainage.

Wheat produced almost as much beef per acre as oats; however, the initial grazing date was approximately 30 days later than for oats. Because of the possibility of damage from freezing of early planted oats, it would be desirable to include wheat in a winter grazing program since it is more winter hardy. Wheat also recovers well from moderate winter grazing and low temperatures and will produce a moderate grain crop if not grazed later than February 15.

A herd of cattle may be continuously grazed during the entire 12-month period, with high rates of beef gains, by employing improved perennial pastures, supplemented by winter pastures, and hay crops. Adequate fertilization and good drainage are necessary, and irrigation should be used as needed. If these practices are followed, the Gulf Coast area of Louisiana will be among the most efficient beef cattle producing regions in the United States.

SEEDING WINTER PASTURES ON RICE STUBBLE

Another approach to the winter pasture problem is presently being investigated to determine the means by which winter grazing can be made available by planting grasses and legumes in rice stubble without seedbed preparation. In the fall of 1952 a number of grasses and legumes were planted in rice stubble, for observation, to determine whether or not this method was practical. Oats, wheat, and white clover were quite successful in the screening test. Three methods of planting oats were tried in the fall of 1953. The methods used were as follows: (1) preparing a good seedbed and planting with a grain drill in the usual manner, (2) dropping the seed in rice stubble, followed by a Caldwell field chopper to mash down the stubble, and (3) dropping seed in the stubble without any further preparation. Two hundred pounds of 16-20-0 fertilizer per acre was applied later as a topdressing on all plots. Grain yields from these treatments were as follows: 44 bushels per acre from plots receiving good seedbed preparation; 55 bushels per acre from plots planted in the rice stubble, where the stubble was mashed down with a Caldwell pasture renovator; and 57 bushels per acre where the seed were dropped in the stubble without any further treatment.

The preliminary studies appeared so promising that a date-of-seeding experiment was planted in the fall of 1954 to determine the optimum period for planting oats and wheat in rice stubble.

Top picture: Typical rice stubble being grazed during the winter months. (Photo taken January 25.) Bottom picture: Heavily grazed oats planted in rice stubble without seedbed preparation. (Photo taken January 25.)

Experimental Procedure

The experiment consisted of a total of 45 acres of rice stubble planted to oats and wheat, with 7.5 acres of oats and 7.5 acres of wheat planted on each of the following dates: October 1, October 15, and November 1. Since a very poor stand was obtained on both the oats and wheat that were planted on October 1, the dates of planting were changed to October 15, November 1, and November 15. The seed were dropped in the rice stubble with a grain drill at the rate of 4 bushels of oats and 1½ bushels of wheat per acre, followed by a Caldwell pasture renovator field chopper to mash down the stubble. Two hundred pounds of 16-20-0 fertilizer per acre was applied at planting time. When the forage was 5 to 6 inches tall, grazing was begun and was continuous until May 9 on the last two dates of planting. Grazing was discontinued March 1 on the October 15 planting so that grain yields could be obtained. The number of cattle on each pasture was regulated according to the forage available. The cattle were weighed every 30 days.

Experimental Results

Excellent stands were obtained from both oats and wheat on all three dates of planting (October 15, November 1, and November 15). Grazing was begun December 15 on the first two dates of planting and January 12 on the last date of planting. Yield data are presented in Table 2. It appears from this test that planting in rice stubble should be made after October 15.

Fifty acres of oats and 13 acres of wheat were planted in rice stubble at the Rice Experiment Station on October 20, 1955. Excellent stands and good growth were obtained from both plantings.

TABLE 2.—Grazing data from date-of-planting test using oats and wheat overplanted in rice stubble

Date of Planting	Days of grazing	Average No. animals /A	Beef production per acre	Grain production /A
October 15	67*	0.62	86	24 bu. oats 16 bu. wheat
November 1	145	0.83	150	. . .
November 15	127	0.48	121	

* Not grazed after March 1. Grain was harvested in May.

Discussion

From the above experiments it appears that oats and wheat definitely have a place on most farms in southwest Louisiana for both winter grazing and grain production. Oats and wheat may be planted either in a prepared seedbed or in rice stubble without seedbed preparation. There are advantages and disadvantages of each method. Earlier planting, which would result in earlier grazing, is possible when oats and wheat are planted in a prepared seedbed; however, the cost would be greater, and the freshly prepared seedbed would not offer a firm footing for livestock, which would result in more bogging during wet weather. Another advantage of stubble seeding is that plantings can be made by airplane regardless of soil moisture conditions which limit preparation of seedbeds and planting thereon. Stubble planting would not be practical on fields that have been seriously cut up by combines under muddy harvest conditions due to drainage difficulties. Regardless of the method of planting, adequate fertilization and good drainage are essential.

Literature Cited

(1) Walker, R. K., and Sturgis, M. B., A Twelve Month Grazing Program for the Rice Area of Louisiana. La. Agri. Exp. Sta. Bull. 407, 1946.
(2) Black, David E., and Walker, R. K., The Value of Pasture in Rotation with Rice. La. Agri. Exp. Sta. Bull. 498, 1955.

letin No. 510 April 1957

La
630.7
L936
no. 510

Food Habits of Louisiana Boys and Girls

how good are they?

ricultural Experiment Station
Charles W. Upp, Director
ouisiana State University and
cultural and Mechanical College

by **RUTH MORRISON**
and **LAUREAME McBRYDE**

TABLE OF CONTENTS

Areas of the Study 3
Selection of the Children 3
The Records 4
Measurement of the Diet 6
Kinds of Food Eaten 6
    Leafy, Green and Yellow Vegetables 8
    Citrus Fruit and Tomatoes 8
    Other Fruits and Vegetables 8
    Potatoes 8
    Milk 8
    Meat, Fish, and Poultry 9
    Eggs 9
    Cereals 9
    Dry Legumes, Nuts, and Cheese 9
    Butter and Margarine 10
Amounts of Food Eaten 10
Deficiencies in the Diet 15
Some Poor Food Habits 22
Some Effects of Deficient Diets 24
Summary 26
References 28

Food Habits of Louisiana Boys and Girls How Good Are They?

RUTH MORRISON AND LAUREAME McBRYDE*

What do the children of Louisiana eat? Is it a satisfactory diet? Will it give them the essential food they need for body building? Does it lack any food element? Does the diet of our children contain enough of the protective foods?

These are a few of the questions asked by nutritionists at Louisiana State University a few years ago. They decided to find out just how well the children of Louisiana were fed. The only way to learn the answers to the questions above was to ask the children or their parents what they were eating. Therefore, a survey of the eating habits of elementary school children was made by some of the Nutrition Staff (1)[1] of the Agricultural Experiment Station at Louisiana State University. This report is a condensation of some of the results of that study.

AREAS OF THE STUDY

Louisiana is easily divided into areas depending on the type of land and crops grown. As a first step in the survey four agricultural areas of the state were drawn on a map of Louisiana (Figure 1). These areas were called Area A, Area B, Area C, and Area D. Area A was the southeastern section of Louisiana known for its sugar plantations and truck farming and included both Baton Rouge and New Orleans. Area B was the southwestern, rice growing part of Louisiana. The northern part of the state was divided into two areas. Area C was the Red River and Mississippi River Delta areas. Area D was the upland piney wood area. Upland cotton farms are found here also.

With these four areas in mind, the next step was to select the schools and the children so that a portion of each area would be represented.

SELECTION OF THE CHILDREN

The number of children selected from each agricultural area was in proportion to the elementary school population of that area as compared to that of the entire state. Seven hundred and fifty-two children from Area A, 127 from Area B, 231 from Area C, and 112 from Area D were selected. Boys and girls, ages 8 through 12 years, were used. All of the children from each school grade selected were subjects. Since many children live in orphanages, the children who were 8 to 12 years of age in four orphanages of the state were asked to keep a record of their diets also. The selection of schools was determined by accessibility of the schools to the University, and the willingness of the parents, school and health officials to cooperate. No child was asked to help until the parent's consent was obtained. The total number of white children in the study was 1,222. There were 623 boys and 599 girls from 19 schools in 12 parishes of the four agricultural areas who participated in the study. Table 1 shows the number of children from each school and parish.

---

*The pictures in this publication were furnished by Louisiana State Department of Education, School Lunch Section, Gladys McCartney, photographer.

[1] Numbers in parentheses refer to the list of references, page 28.

THE RECORDS

The simplest way to know what a group of children (or adults for that matter) are eating every day is to ask them to write down

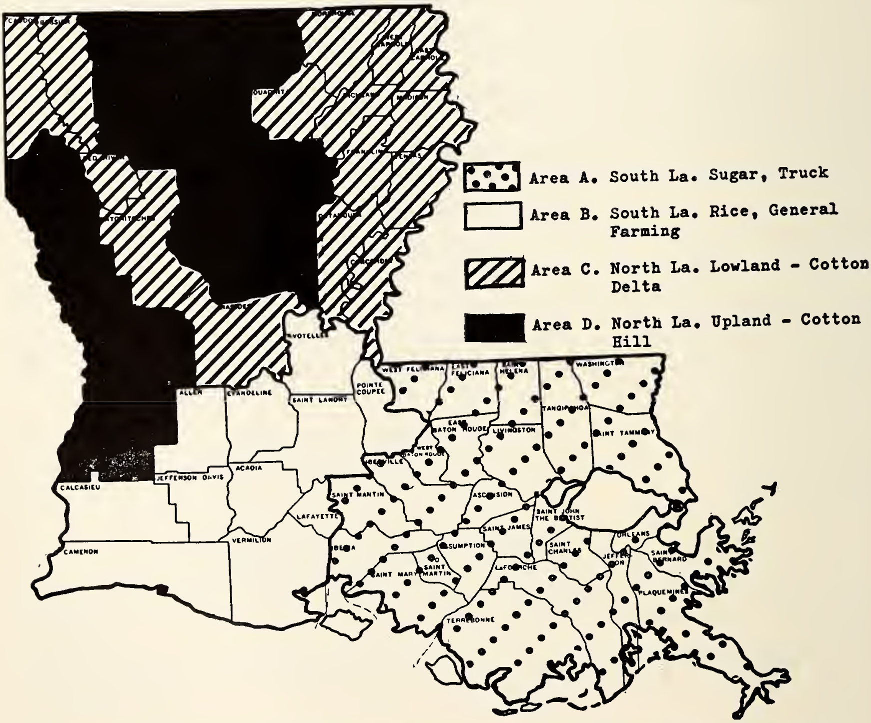


Figure 1. Division of Louisiana According to Types of Farming.

TABLE 1. Distribution of 1,222 Subjects According to Agricultural Area, Parish, and School

Agricultural Area	Parish	School	Number of Subjects
Area A	East Baton Rouge	Dufrocq	56
		Highland	66
		Protestant Orph.	6
		University High	105
		Woodlawn	51
	Orleans	Gentilly Terrace	115
		Gumbel	12
	Iberville	Plaquemine Elem.	81
		Crescent	77
	St. Martin	Breaux Bridge	80
	St. Tammany	Covington	103
	Total Area A		752
Area B	Avoyelles	Bunkie	71
		Marksville	56
	Total Area B		127
Area C	Bossier	Bossier Elem.	99
	Franklin	Winnsboro	74
		Wisner	25
	Ouachita	Baptist Orphange	17
	Rapides	Masonic Home	16
	Total Area C		231
Area D	Lincoln	Eastland	19
		Junior High	32
	Winn	Winnfield	61
	Total Area D		112

what they eat. That is what the children on this study were asked to do. They kept a record of everything they ate or drank, whether it was part of a meal or a snack, for seven days. The nutritionists taught the older children how to use the record sheets and the parents helped the younger children. At the end of the week the records were collected. The foods eaten were classed by food groups and a count was made from the records.

MEASUREMENT OF THE DIET

How Are the Needs of Children Measured?

There are several ways to find out whether a person eats the food that will make him a healthy, well-nourished individual or whether he has a diet that is deficient in some essential nutrient. Nutritionists have found that a person must eat certain amounts of a variety of food or he will lack some vitamin or mineral important to good health.

One way of measuring the amount of a vitamin or a mineral or the number of calories contained in a food is to take the food into a chemical laboratory and analyze it. Or, the figures for the nutrient value of each food eaten can be found in books containing tables of food values and the actual amounts of each nutrient can be calculated.

An easier and quicker way to measure the adequacy of a diet is to divide the meals for a day (or a week) into food groups according to a pattern given by the Food and Nutrition Board of the National Research Council. This board was organized in 1940 to advise on problems of nutrition in connection with National Defense. In addition to this service the Board has published recommended allowances (3) for ten nutrients (calories, protein, calcium, iron, vitamins A, C and D, riboflavin, thiamine, niacin). These "allowances" were based on the findings of research workers in nutrition all over the country and were the amounts of each nutrient recommended (or needed) for the best nutritional health.

In addition to these "Recommended Allowances" a pattern (4) for an adequate diet was made. The foods important for good nutrition were classified into seven groups based on nutritional content and use in meals. This was known as the "Basic Seven" and first was used in nutrition classes during World War II. This same pattern was used to divide into groups the foods found in the diets of the Louisiana children. Some of the food groups were sub-divided so that 10 food groups were formed. Table 2 shows these food groups and the number of servings needed each week for a good, nutritious diet. A serving was the amount of each food ordinarily eaten at one time, such as one-half cup of a fruit or a vegetable, three ounces of meat, one egg and one glass of milk.

KINDS OF FOOD EATEN

What Do the Children of Louisiana Eat?

This question was answered by the records the children kept of what they ate each day for a week. The number of servings of

TABLE 2. Ten Food Groups and Recommended Number of Servings

No. of Servings		Food Groups
Daily	Weekly	
1	7	Leafy, green and yellow vegetables
1	7	Citrus fruit and tomatoes
2	14	Potatoes, other vegetables and fruits
2	14	Milk, ice cream
1	7	Meat, poultry, fish
*	*	Legumes, nuts, cheese
	5	Eggs
2	14	Bread, flour, cereals, whole-grain or enriched
2	14	Butter and margarine

*Used as meat substitutes.

each food was counted for each child separately. Then the average number of servings of each type of food for all the children in one school were figured. In the same way the average number of servings of foods in each food group was made for each area. These averages were compared to the recommended number of servings for that food group given by the National Research Council.

What does an average mean? It doesn't mean much when individual children are to be considered. For example, the average number of eggs consumed in Area A was four per week. The average number of eggs eaten by the children in one school was two, in another it was six eggs, in another five, and in another school three eggs. The average number for the whole area, then, was four. Seventy-five children had no eggs and 196 children had less than three eggs a week in this area. An average is a general figure and should be used with care. If only 60 or 70 per cent of the children are well-fed, the other 30 or 40 per cent of the children should not be forgotten even though the "average" amount eaten appears to be adequate.

A combination of foods from all the 10 food groups is necessary so that all of the essential nutrients are included in the diet. Each group of foods contributes several of the nutrients but no one food contains everything required for a health-giving diet. The kinds and the amounts of food eaten by the children in Louisiana, as it was divided into the 10 groups, follow.

Leafy, Green and Yellow Vegetables

One or more servings of leafy, green or yellow vegetable should be eaten each day. This adds up to seven or more servings a week. In Louisiana the children ate green vegetables such as mustard, turnip tops, cabbage, collards, spinach, broccoli, lettuce (and other salad greens), green peppers, peas, and green string beans. Yellow vegetables eaten by the children were carrots, sweet potatoes, yellow squash, corn, and pumpkin. These vegetables are the main source of vitamin A. Also, some vitamin C is found in these vegetables, if the vegetables are eaten raw. Cooking of the vegetables destroys the vitamin C but not the vitamin A. Vegetables also supply some minerals to the diet.

Citrus Fruit and Tomatoes

It is essential to eat one serving or more of citrus fruit or tomatoes daily to insure an adequate amount of vitamin C (ascorbic acid) in the diet. The children ate oranges, grapefruit, and tomatoes raw most of the time. Cooked tomatoes, lemonade, strawberries, and some melons were eaten, also, and are very good sources of vitamin C. Tomatoes also supply vitamin A.

Other Fruits and Vegetables

In addition to the leafy, green and yellow vegetables the children ate many other kinds of vegetables. Also, fruit other than citrus fruit was eaten. The "other fruits and vegetables" reported included beets, lima beans, turnips, cucumbers, celery, onions, apples, bananas, grapes, pears, fruit mixtures, prunes, and other dried fruits. These foods contribute some vitamins and minerals and are necessary supplements to the diet. Variety in food selection is essential for pleasure in eating as well as to aid in preventing deficiencies.

Potatoes

White or Irish potatoes furnish energy and, if they are eaten daily, an appreciable amount of vitamin C is added to the diet. Louisiana children do not eat them daily. However, the other vegetables which were eaten, plus the large quantity of cereals consumed, added needed calories and minerals to the diet.

Milk

All children need milk. It is impossible for growing children to get sufficient calcium for building bones and teeth without milk. Milk is a good source of riboflavin, one of the B vitamins. Although the green vegetables, eggs, and enriched cereals contain this vitamin, milk is the richest food source. Cheddar cheese and ice cream, which contain milk, also are rich sources of calcium and riboflavin. Milk contains nearly all the other food nutrients so is called "the most perfect food." In Louisiana most of the children drank plenty of milk.

Meat, Fish, and Poultry

At least seven servings a week of some kind of meat is essential to furnish the protein needed by growing children. Meats also contribute the B vitamins to the diet. The children of Louisiana are fortunate to be in a state where a very wide variety of meats is available. The children ate the usual meats—beef, veal, lamb, fresh pork, and ham—prepared in a variety of ways. Fish is plentiful in Louisiana, and oysters, crab, shrimp, crayfish, and many other kinds of fresh and canned fish were eaten. Chicken and some turkey were included in the diets as well as wild birds (duck, quail) and game (squirrel and rabbit). The abundance of meat, fish, and poultry in Louisiana was reflected in the large amount of this type of food eaten.

Eggs

Eggs are an important source of protein, iron, riboflavin, vitamin A, and some of the other vitamins. They are a necessary supplement to meat since eggs contain some nutrients lacking in meat. Louisiana children ate fewer than the five eggs a week recommended by the National Research Council.

Cereals

In Louisiana the law requires the enrichment of all wheat flour and breads with certain nutrients (some of the B vitamins, calcium, and iron). The total requirement for these nutrients cannot be obtained by eating bread, but enriched bread contributes much to make diets adequate in these nutrients. Cereals of all kinds are energy giving foods, so essential to the active child. Louisiana children eat large amounts of enriched white bread. In addition the consumption of rice, macaroni, spaghetti, hominy grits, breakfast cereals, and some corn meal was reported. Not much whole grain bread or cereals were eaten.

Dry Legumes, Nuts, and Cheese

Dry legumes, nuts, and cheese are rich sources of protein. The quality of protein in dried peas and beans is not as good as the quality of meat, egg, and milk proteins, but legumes are a cheaper source of protein and of some of the B vitamins. Generally, these foods are classed as "meat substitutes" and can be used to add variety to the diet. They should replace only part of the meat.

Butter and Margarine

All fats add calories to the diet. Butter and margarine contribute vitamin A to the diet in addition to calories. Other fats do not contain this vitamin. In Louisiana, margarine was reported more often than butter, except that butter was served for the school lunch. Butter contains some vitamin A, and this vitamin is added to margarine, making both important sources of the vitamin.

AMOUNTS OF FOOD EATEN

How Well Do the Children of Louisiana Meet Requirements?

Now let's turn back to the children in each of the four areas of the state. As was shown in the previous section, the children are eating some food from each group. Are the white children of Louisiana eating enough of these foods? One can see from Table 3 that the children of the state eat plenty of some foods but not enough of the others. As the following graphs (Figures 2-9) show, the type of foods eaten differs from one area to another.

The children in southern Louisiana and in the delta areas do not eat enough green and yellow vegetables or citrus fruit. Children

TABLE 3. Average Number of Servings Eaten by Children in Four Areas of Louisiana

Food Groups	Amounts Needed*	Area A	Area B	Area C	Area D
Leafy, green, yellow vegetables	7	6	6	6	10
Citrus fruits and tomatoes	7	6	6	5	7
Potatoes	7	4	5	4	5
Other fruits and vegetables	7	10	8	11	11
Milk	14	19	16	15	14
Eggs	5	4	4	4	4
Meat, poultry, fish	7	11	8	10	7
Meat substitutes	**	5	3	4	3
Cereals, enriched or whole grain	10	20	17	19	16
Butter or margarine	14	8	4	7	6
Sugars and sweets	Calories only	17	11	19	8

*National Research Council Recommendation.
**Meat substitutes include dry legumes, nuts, and cheese and may replace 2 to 3 servings of meat.

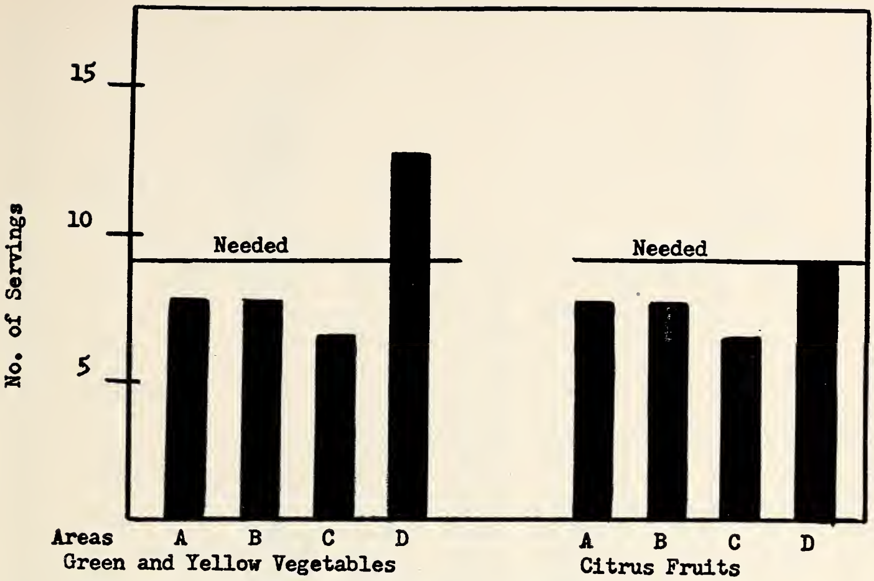


Figure 2. The Children in Southern and Eastern Louisiana Need More of These.

need at least seven servings a week from each of these two food groups. The average number of servings of each of these food groups in Areas A and B was six, but in Area C only five servings a week were eaten by the average child. Since this is an average, it means that some children ate less. In Area D the children ate plenty of green and yellow vegetables and the required amount of citrus fruit. Since all the children reported that they ate small quantities of margarine and butter, the amount of vitamin A in many diets is probably low. The amount of vitamin C is undoubtedly low in many children's diets also (Figure 2).

Figure 3 shows the number of servings of potatoes and of fruits and vegetables other than the green or yellow vegetables and citrus fruits. Louisiana's children eat a variety of these fruits and vegetables but not many potatoes. In Area B the children need more vegetables of all kinds.

The children in all areas had plenty of milk especially when ice cream was included in the count of the number of servings (Figure 4). Too, all children had enough meat. When all protein foods were averaged together, Areas A, B, and C exceeded the required number of servings (two servings a day, or 14 servings a week) and Area D met this requirement (Figures 5, 6). However, for the best diet, a child should have five eggs a week. Only an

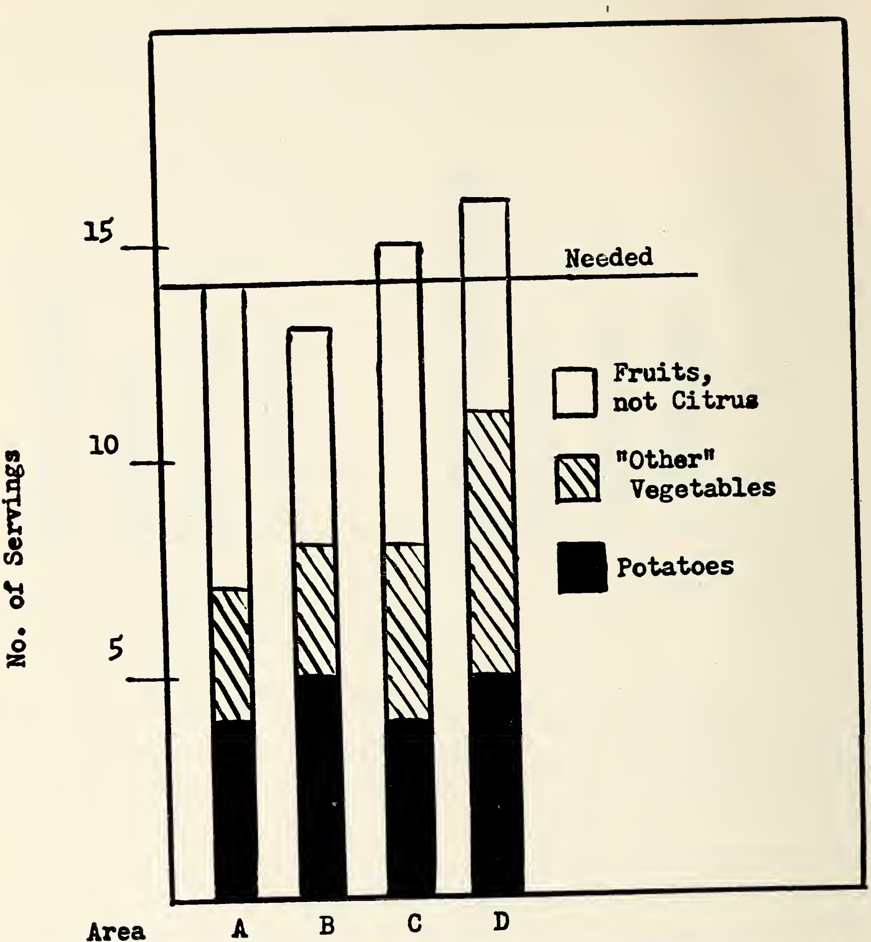


Figure 3. Louisiana's Children Eat a Variety of Fruits and Vegetables but Not Many Potatoes.

average of four eggs a week were eaten by the children in all the areas of the state.

Cereal foods are well liked in Louisiana. All children ate an abundance of enriched bread, which was usually white bread. Rice was eaten frequently. In fact, this cereal is more common in all areas of Louisiana than white potatoes and possibly replaces the potatoes to some extent. More rice was eaten in the upland area and in the rice growing area but the children in other areas also enjoy rice. Grits and spaghetti were more commonly eaten in Area A, and corn meal was popular in Area D (Figure 7).

The minimum of 14 servings of butter or margarine a week was not met (Figure 8). Whether this is the actual fact or whether

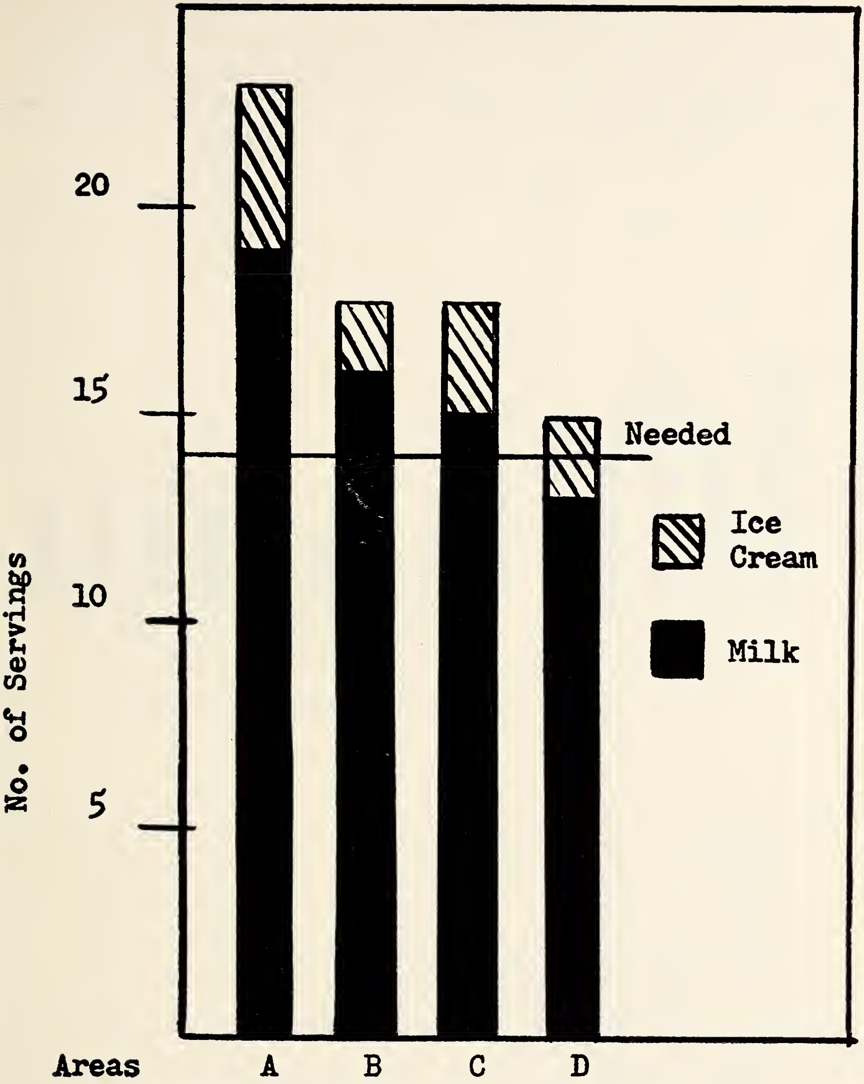


Figure 4. Plenty of Milk for Most of the Children.

the children failed to record the amount eaten is not known. Possibly the records were incorrect. The other fats eaten add to the number of calories for the day but do not furnish needed vitamin A.

It is interesting to note the differences in the amount of sweets and sweet desserts eaten in the four areas. The children in Area A, the sugar cane area, and in Area C, the delta area, ate more sweets than did those in Areas B or D (Figure 9).

On the whole the children of Louisiana appear to be well nourished. The deficiencies in the diet of the average child are few and the foods which do not meet the standards are eaten in nearly adequate amounts. However, how many children have diets which are dangerously low in some of the nutrients?

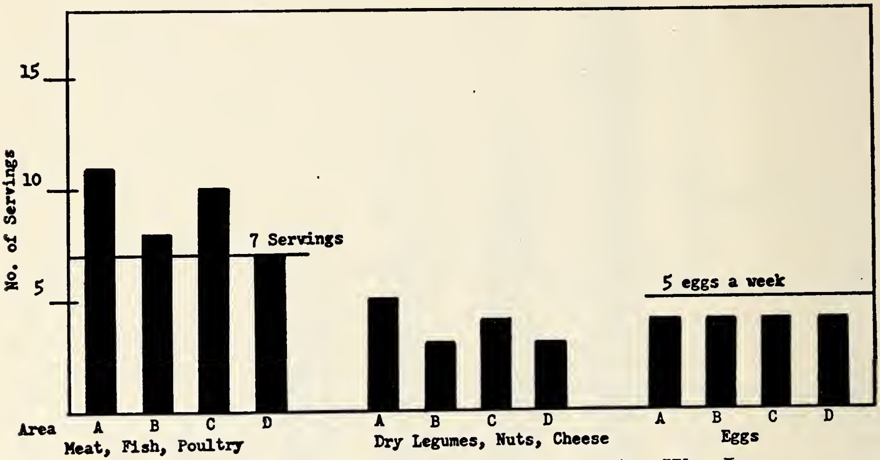


Figure 5. The Average Number of Eggs Eaten Was Low.

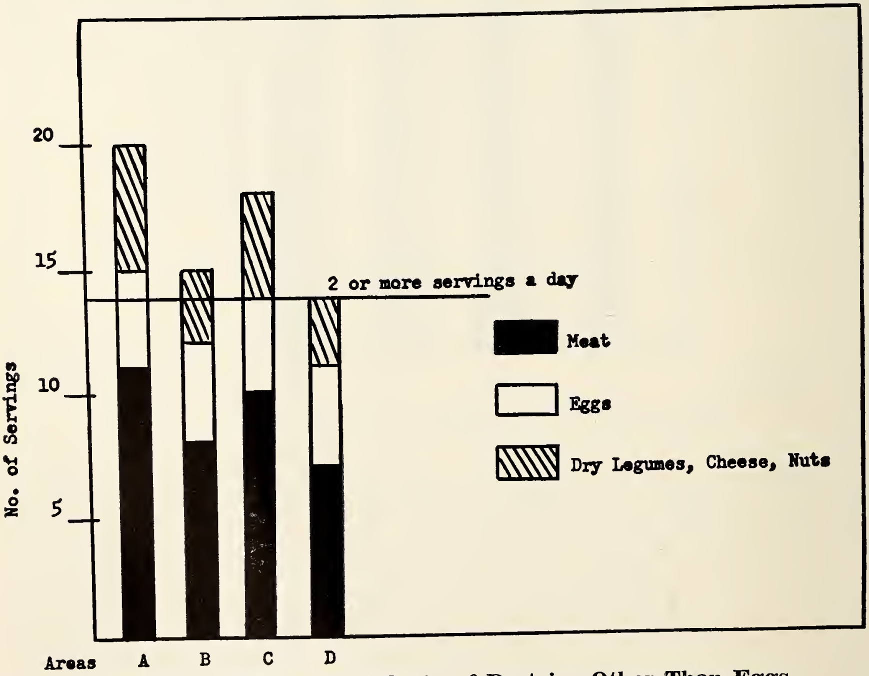


Figure 6. Children Ate Plenty of Proteins Other Than Eggs.

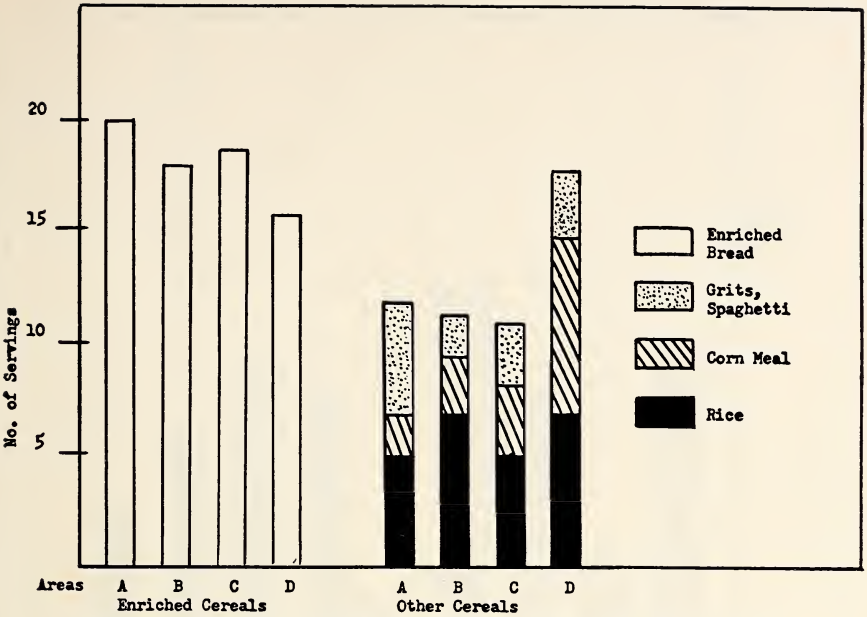


Figure 7. Cereals of All Kinds Were Abundant in the Diet.

THE DEFICIENCIES IN THE DIET

How Many Children Have An Inadequate Diet?

Table 4 and Figures 10 and 11 show that many of the children of the state do not have an adequate diet. Some eat ample amounts of the necessary foods. Others eat a fair amount of the essential food nutrients. Still other children have a diet totally lacking in one or more required foods. Count the number of children who have less than two-thirds the recommended amounts. Three food groups (leafy, green and yellow vegetables; citrus fruits; and eggs) should be given special consideration. In Area A, 248 children of the 752 ate less than two servings of leafy, green and yellow vegetables a week and 23 of these children had none. In Area B only 127 children were included in the study but 28 of these had too few of the leafy, green and yellow vegetables. In Area C, 60 children of the 231 studied failed to eat two-thirds of the required amount. In Area D only three children did not eat enough of these vegetables.

The lack of citrus fruits and tomatoes usually results in a diet deficient in vitamin C. In Area A, 45 children, or 6 per cent, had no foods from this group and 271 children (30 per cent) did not eat

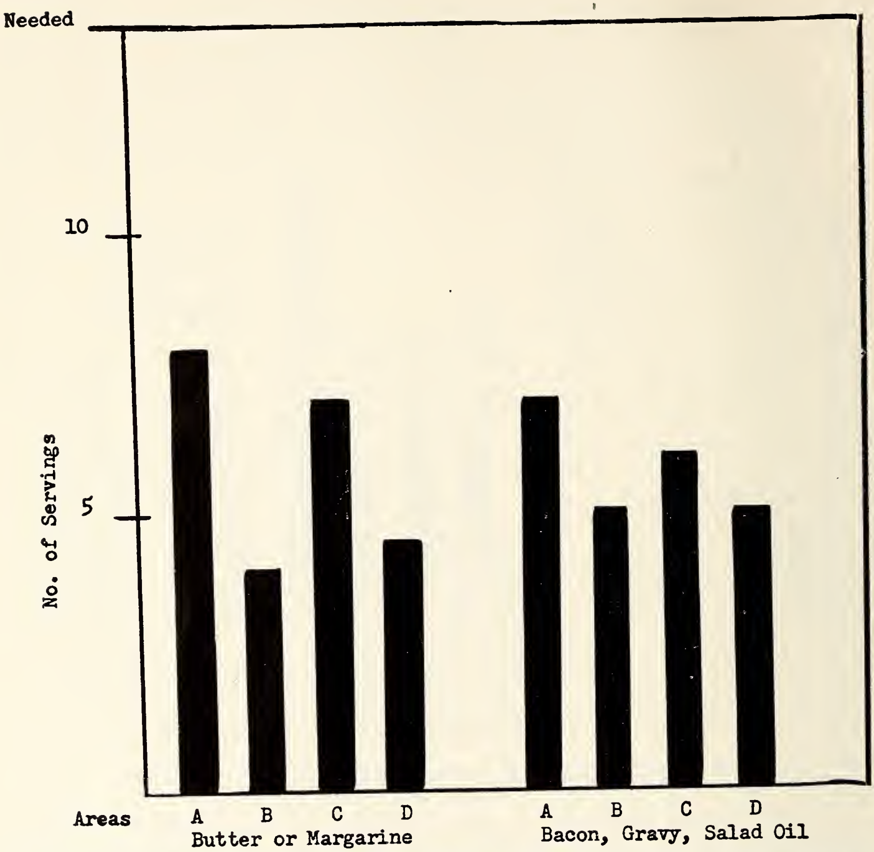


Figure 8. **Vitamin A Is Found in Butter and Margarine, Not in Other Fats.**

enough of this food. The percentages of children who had insufficient citrus fruit or tomatoes in the other three areas were 23 per cent in Area B, 45 per cent in Area C, and 17 per cent in Area D. It is well to note that this number in Area C represents nearly half of the children studied in that area. Some vitamin C may be obtained from other sources. The leafy, green vegetables (cabbage, broccoli) furnish appreciable amounts of this vitamin if they are eaten raw. However, many children in Areas A, B, and C ate insufficient amounts of these vegetables. When Irish potatoes are eaten daily, the vitamin C in the diet is increased. One serving of potatoes contains one-third as much vitamin C as a small orange. The amount of potatoes eaten by the children was low since rice was used often instead of potatoes. From the findings of this study one might expect to find some children who received insufficient amounts of vitamin C. This is one deficiency that should be

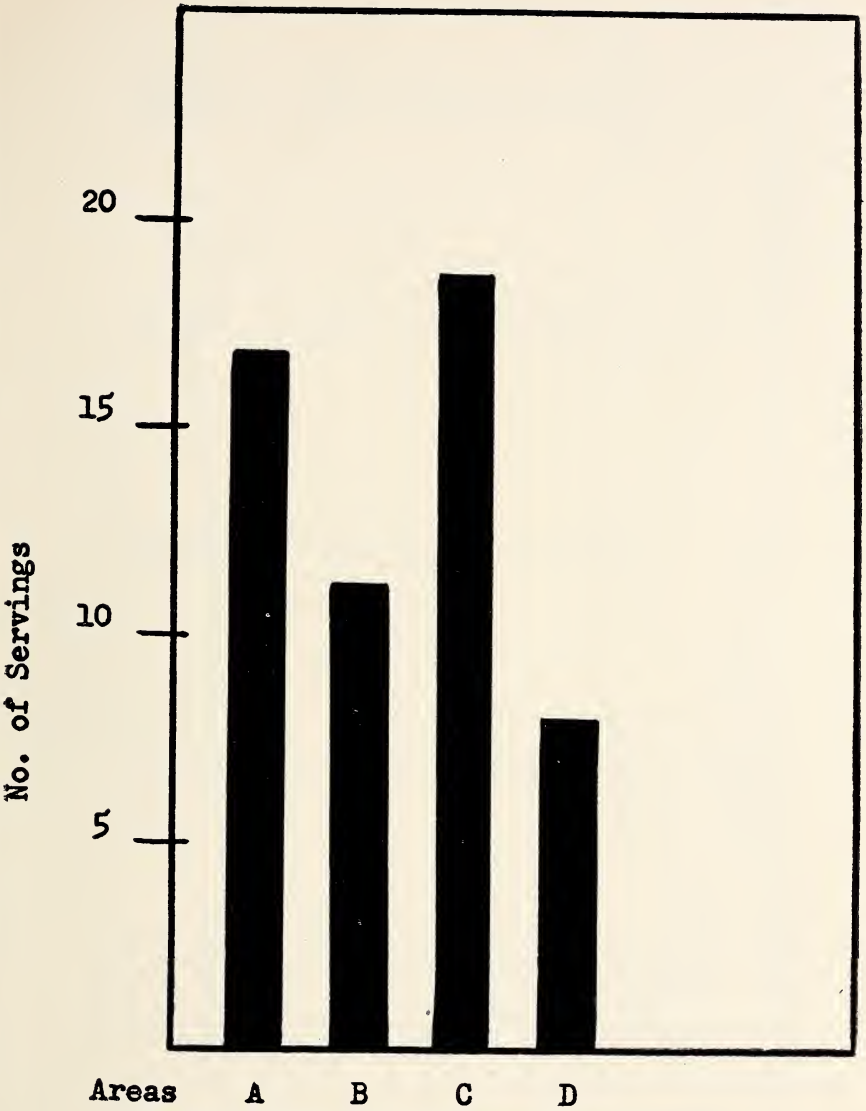


Figure 9. Cake, Pie, Cookies and Other Sweets.

guarded against in Louisiana. In the strawberry season or when oranges are plentiful the children undoubtedly eat more fruits high in vitamin C.

About a third of the children studied in all areas of the state ate too few eggs. In Area A, 271 children ate fewer than three eggs a week; 75 of these children ate none. In Area B, 44 children

TABLE 4. **Percentage of 1,222 Children of the Four Agricultural Areas Whose Dietaries Contained 100, 99 to 57 Per Cent, 57 Per Cent to 1 Per Cent, or None of the Protective Food Groups as Recommended by National Research Council**

Food Groups	Per Cent of N. R. C. Allowance	Agricultural Area			
		Area A 752 Subjects	Area B 127 Subjects	Area C 231 Subjects	Area D 112 Subjects
Green, leafy and yellow vegetables	100% & above	38	43	46	80
	99 - 57	29	35	29	18
	57 - 1	30	21	22	3
	0 Servings	3	1	4	0
Citrus fruit and tomatoes	100% & above	39	47	33	41
	99 - 57	25	31	23	41
	57 - 1	30	22	41	17
	0 Servings	6	1	4	0
Other vegetables and fruits	100% & above	67	59	78	80
	99 - 57	23	25	15	17
	57 - 1	10	15	7	4
	0 Servings	1	1	0	0
Potatoes	100% & above	17	19	20	23
	99 - 57	35	47	39	43
	57 - 1	45	34	37	30
	0 Servings	3	1	5	4

(Continued)

TABLE 4 (continued)

Food Groups	Per Cent of N. R. C. Allowance	Agricultural Area			
		Area A 752 Subjects	Area B 127 Subjects	Area C 231 Subjects	Area D 112 Subjects
Milk	100% & above	81	78	65	61
	99 - 57	15	16	22	23
	57 - 1	4	6	12	16
	0 Servings	0	1	1	0
Meat, fish and poultry	100% & above	82	74	87	65
	99 - 57	16	23	11	25
	57 - 1	2	3	2	10
	0 Servings	.1*	0	0	0
Eggs	100% & above	38	32	32	45
	99 - 57	26	33	30	31
	57 - 1	26	28	31	14
	0 Servings	10	7	7	10
Cereal grains and their products	100% & above	90	84	94	68
	99 - 57	7	13	5	28
	57 - 1	3	2	1	4
	0 Servings	.1*	0	0	0
Butter and margarine	100% & above	21	2	12	9
	99 - 57	28	13	34	25
	57 - 1	44	60	48	58
	0 Servings	8	25	7	8

*1 child.

TABLE 5. The Percentage of Children with Less than 57 Per Cent of Recommended Amounts

Food Groups	Area A	Area B	Area C	Area D	Average All Schools
Leafy, green, yellow vegetables	33	22	26	3	28
Citrus fruits, tomatoes	36	23	45	19	35
Other fruits and vegetables	11	16	7	4	11
Potatoes	48	35	42	34	44
Milk	4	7	13	16	7
Meat, fish, poultry	3	3	2	10	3
Eggs	36	35	38	24	35
Cereal	4	2	1	4	3
Butter - margarine	52	85	55	66	57

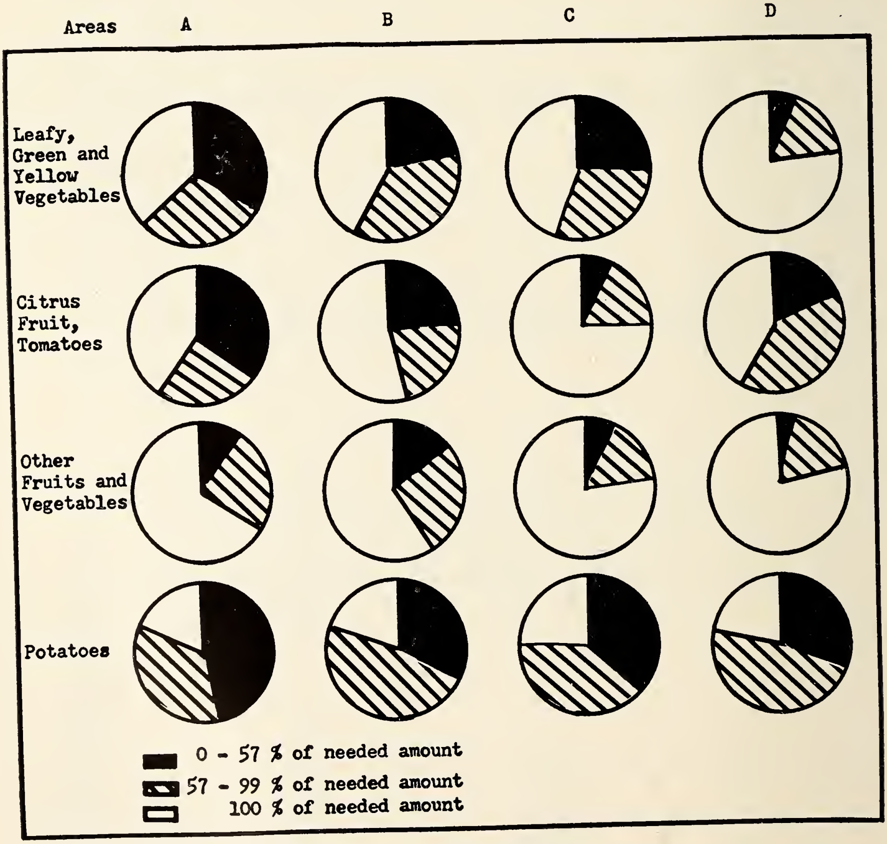


Figure 10. The Proportions of Children Who Had 0-57 Per Cent, 57-99 Per Cent, and 100 Per Cent of the Fruits and Vegetables Needed.

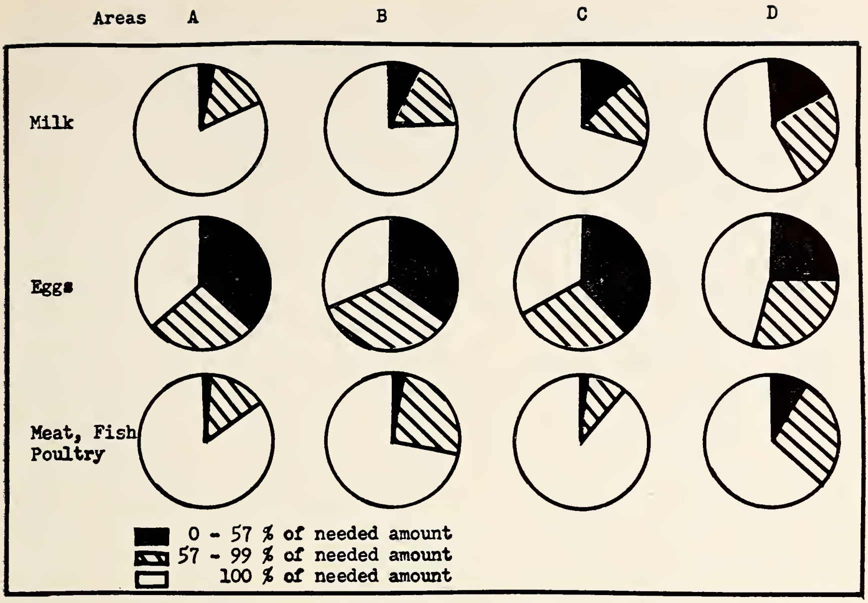


Figure 11. The Proportions of Children Who Had 0-57 Per Cent, 57-99 Per Cent, and 100 Per Cent of the Protein Foods Needed.

ate fewer than three eggs and 9 children ate no eggs during the week studied. Eighty-eight children in Area C ate fewer than the three eggs and 16 ate none. In Area D, 45 per cent of the children had five or more eggs a week but 11 children ate none and 30 children ate too few eggs.

The large amounts of meat eaten by the children and the more than adequate milk consumption partially compensate for the inadequacy in the number of eggs eaten. Meat, milk, and eggs are all good sources of protein. Milk contains many of the other nutrients found in eggs, with the exception of iron and vitamin A. Most varieties of meat are high in iron. The deficiency in eggs, therefore, is not as critical as it might seem at first.

Ninety-three per cent of all the children drank sufficient milk. This means that of the 1,222 children, 86 did not drink enough milk. In Area D the highest percentage had insufficient milk; 16 per cent, or 18 children, said that they drank less than two-thirds of the required amount of milk. While most of the children are getting the milk they need, the few who do not must be considered. The recent emphasis on the school lunch undoubtedly has corrected this deficiency in many cases (5).

Cereal products are well eaten by all children. In all areas ample amounts of enriched cereal in the form of white bread are eaten. Very few children consumed less than two-thirds the requirement, though one child did not eat any enriched cereal.

A large percentage of children did not have sufficient butter or margarine. These children apparently eat less than the needed amounts of the three main food sources of vitamin A (leafy, green and yellow vegetables, eggs, butter or margarine). Certain fruits such as peaches and apricots contain appreciable amounts of this vitamin. Also, ice cream and cream add to the day's needs. Perhaps more margarine and butter were used than was reported. The lack of foods rich in vitamin A in the meals of Louisiana children should be remedied.

To sum up, the meals of many children (Table 5) in Louisiana are lacking in:

1. Foods that furnish vitamin A
    Leafy, green and yellow vegetables
    Butter and margarine
    Eggs
2. Foods that are high in vitamin C
    Citrus fruit and tomatoes
3. A food that is rich in iron, riboflavin, and vitamin A as well as in high quality protein.
    Eggs

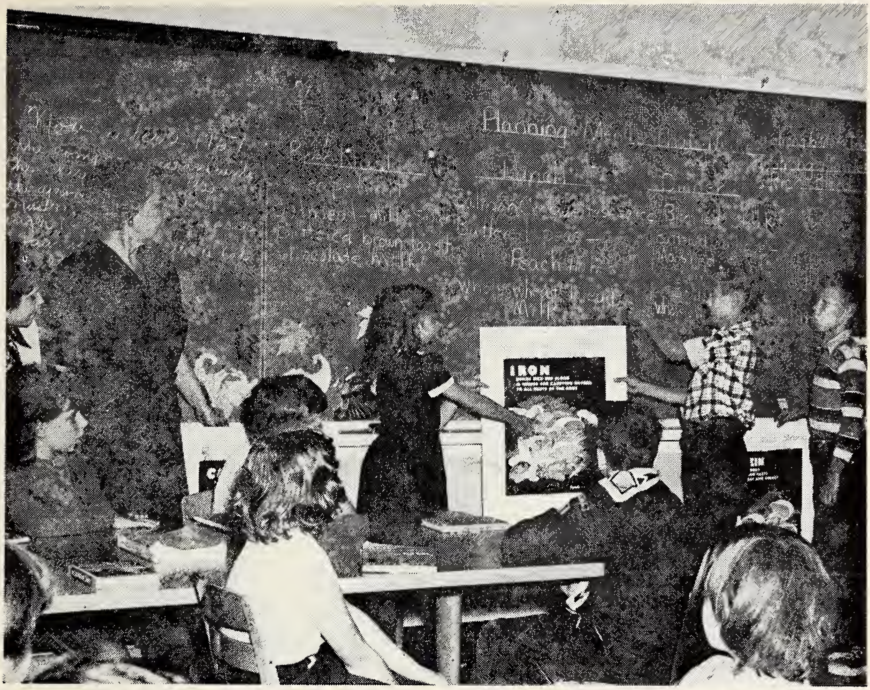
Generally the other foods were eaten in adequate amounts by most of the children.

SOME POOR FOOD HABITS

What Other Foods Do the Children Eat?

The children in Louisiana eat many desserts, candies, carbonated beverages, and other sweets. Such foods supply calories in the diet but very little of the other nutrients. Children need some high caloric foods, since an adequate intake of calories is essential to growth. When too many sweets are eaten, other foods usually are excluded from the diet.

The majority of children ate many of these sweet foods between meals. The amount and kind of food eaten depended on the individual child. Some ate only a little fruit, others ate nearly a full meal at irregular times of the day. The foods eaten between meals included the usual snack foods: ice cream, candy, soft drinks, fruit, sandwiches, cookies, cake, and pie. Hard candy and ice cream were eaten frequently. Soft drinks were not reported as often as might be expected. Milk was taken rarely between meals. Such foods as sausage, baked sweet potato, meat balls, and rice were re-



Learning the Value of Good Nutrition.

ported as "snacks" eaten between meals. Many children ate something between breakfast and lunch or after supper. The greatest number of snacks was eaten after school and before supper. Some children ate frequently during the day. Very few ate less than four times regularly every day.

Poor appetites at mealtime result from eating too much between meals. If the snack is a food which is low in nutrients (except calories) and if the child then fails to eat the needed food essentials, a poor diet results. If the snack supplements the diet by furnishing the required nutrients, the snack, itself, helps to improve the child's diet. Snacks, consisting of fruit, milk, ice cream, or highly nutritive cookies (such as molasses cookies) are much preferable to the consumption of candy, carbonated beverages, or rich pastry. Ice cream furnishes many essential nutrients and is widely eaten between meals. It should not be eaten in place of fruit, vegetables, and other necessary food, however.

The children in the four areas all ate between meals to some extent. In Areas A and C more cakes, pies, cookies, and concentrated sweets were eaten (Figure 9) than in the other two areas.

The large amounts of concentrated sweets eaten by the children in these two areas is especially interesting. Much of this "concentrated sweet" was candy. It should be noted that in these two areas fewer children had enough citrus fruit than in Areas B and D. Perhaps these children might be taught to eat fruit instead of candy between meals.

Another poor food habit noted among many Louisiana children was the missing of regular meals. Sometimes a snack (usually pop corn or candy) replaced the regular meal. The meal most often missed was supper, though some children missed breakfast or, occasionally, lunch. Many times a child missed a meal on Saturday or Sunday. The reason given was that the child had gone to the movies, eaten popcorn and so was not hungry for supper. The missing of meals was not habitual with certain children, apparently, but was not unusual for a number of them. This habit again leads to a poor diet.

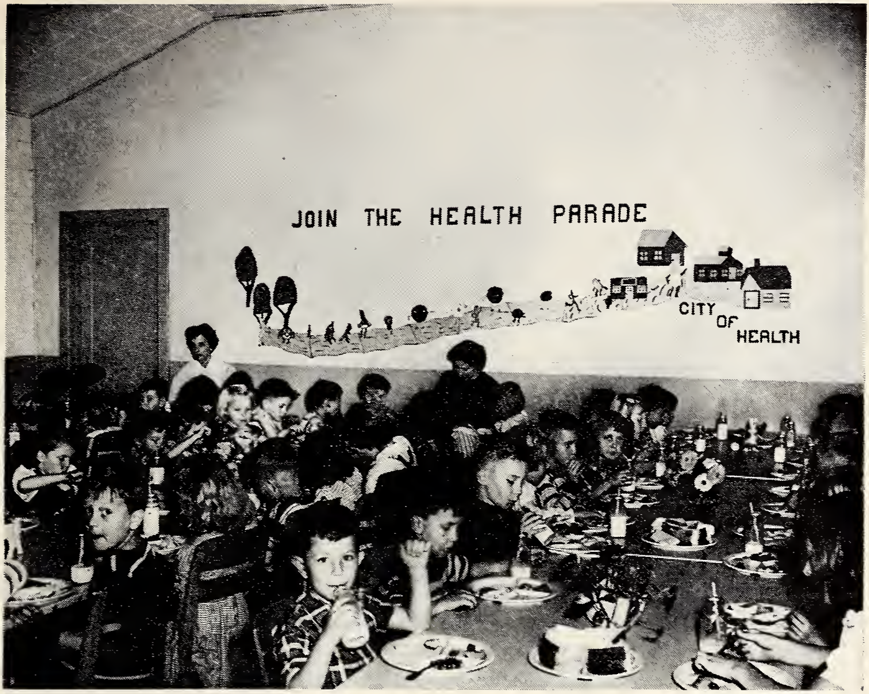
Children will always, at times, eat snacks. What children eat is more important than when they eat it. Children can be given the more nourishing foods between meals, can be taught to eat more regularly, and can learn the importance of eating nutritious food. Parents must be taught also the need for furnishing their children with the essential foods for growth and development.

SOME EFFECTS OF DEFICIENT DIETS

Can the Results of An Inadequate Diet Be Seen?

Are there ways of knowing how a poor diet affects a child? It is very difficult to find any direct relationship. The effects of a sub-optimal diet appear slowly. Many of the necessary food elements are vitally needed for the growth of bone, muscle, and tissue. Other nutrients function to preserve the health and maintenance of body tissue. Still others aid the work performed by the body such as digestion, the transformation of food into energy, the building of blood, or the activity of the organs of the body. Since the uses of the food eaten are so varied and since most functions of the body partially depend upon the food a person eats, it is nearly impossible to point to the direct result of poor eating habits. The results of a poor diet may not be seen in the child but the habitually poor diet eaten over the years of growth may develop into serious complications in the health of the older individual.

Various measurements have been used in the attempt to judge the nutritional well-being of children. A few of the children



Good Lunches Mean Better Health.

who took part in the dietary survey were studied more closely to try to determine the effect of either a good or a poor diet on the children (6). Most of these children were from schools in Area A. Sixty-two children in Bossier elementary school in Area C were used also.

One way nutritionists measure whether a person has enough of a certain nutrient (usually a vitamin) is to find out how much of that nutrient is in the blood. The amount of vitamin A and vitamin C in the blood of 425 children from Area D and 62 children from Area C was studied (6). The hemoglobin of the blood also was measured. A doctor examined the children, looking for visible physical signs of poor nutrition, such as, changes in the skin; redness on the edges of the tongue; red, sore gums; and even poor posture. All this information was combined with the findings in the dietary survey of the same children. The investigators then tried to see if there was a connection between the diets and the physical or chemical measurements.

It was found that the effects of vitamin A deficiency in the diet are not easy to see immediately. Five per cent of the children had an amount of vitamin A in their blood which was considered too low for good health. Although some of the clinical symptoms of vitamin A deficiency were found in a few children, it was impossible to relate them directly to a diet low in this vitamin.

Thirty per cent of the children had a low amount of vitamin C in their blood serum (6). There was some evidence that a bleeding or a redness of the child's gums might be connected to a low amount of vitamin C (ascorbic acid) in the blood serum. Also, there was some indication that the amounts of this vitamin in the blood serum may depend upon vitamin C content of the diet.

The amount of hemoglobin in the blood is indicative of a good supply of iron in the diet. In the condition known as "nutritional" anemia the amount of hemoglobin in the blood becomes lowered. Ninety-five per cent of the children studied had a normal amount of hemoglobin. Since most of the children ate an adequate amount of meat, their supply of blood building material was ample.

As the result of these tests it was seen that it is difficult to measure the effects of a sub-optimal diet unless some extreme deficiency is present. The diets of most of the children were good. Some children did not receive an optimal diet, and a few diets might be classed as poor. Extreme deficiency symptoms do not appear until the nutrient has been very low or lacking from the diet for a long period. However, slight deficiencies do appear. For example, there appeared to be a connection between sore, bleeding gums and vitamin C deficiency. The results of all these studies are reported in detail by Moschette and others (6). The long-time effects of slight deficiencies are unknown. It is certain, however, that for maximum growth and for the best of health, an adequate diet is essential.

SUMMARY

The Questions Answered

How Were the Needs of the Children Measured?

The foods eaten daily by each child were divided into ten classes. Foods from each of these groups must be eaten daily to assure a diet adequate in every respect. The ten food groups were:

Leafy, green and yellow vegetables
Citrus fruit and tomatoes
Other fruits and vegetables
Potatoes
Milk
Eggs

Meat, fish, and poultry
Legumes, cheese, and nuts
Enriched or whole grain cereals
Butter or margarine

The number of servings each child ate from each of these groups was counted and compared to the amounts recommended by the National Research Council.

What Do the Children of Louisiana Eat?

The children in the schools studied ate some food of each type. They ate a variety of leafy, green and yellow vegetables. Some had plenty of citrus fruit. Many ate more of the other kinds of fruit and vegetables. Rice was eaten frequently in place of Irish potatoes. The protein foods (milk, meat, eggs) were eaten by all children in all areas. Cereals of all kinds were well liked. In addition to white bread, the other cereals which were popular in various areas were rice, spaghetti, hominy grits, and corn meal.

How Well Do Louisiana Children Meet Requirements?

The children failed to eat enough of four types of food: leafy, green and yellow vegetables; citrus fruit and tomatoes; eggs; and butter or margarine. In Areas A, B, and C there were many children who did not have enough leafy, green or yellow vegetables and who ate inadequate amounts of citrus fruit or tomatoes. Too few eggs were eaten by the majority of children and many children did not eat any. Butter and margarine were eaten in small quantities. On the whole it appeared that the children ate insufficient amounts of the foods containing vitamins A and C.

How Many Have Inadequate Diets?

About 30 per cent of the children in the schools studied have diets that are inadequate in some respect. This means that of the 1,222 studied, 367 children did not have the optimum diet for growth and health.

What Are the Results of an Inadequate Diet?

The results of an inadequate diet are difficult to measure. There are certain physical and chemical tests which are used as indicators of dietary deficiency but these tests do not reflect directly the dietary intake. Slight symptoms of deficiency are not recognized easily. Good health can result only if the diet has been completely adequate.

What Can Be Done in Louisiana to Improve the Diets?

Emphasis should be placed on the importance of vitamin rich food in the diet. Children, their parents, and their teachers should be given instruction in food needs. The school lunch has aided materially in increasing the protective foods in the diets of many children. Also, the school lunch can be used as a teaching medium to show children how to select nutritious foods. The selection and preparation of food so as to preserve vitamin content must receive added emphasis.

Several ways to improve the eating habits of children are:

1. Training the children to like and to select the foods that are good for them.

2. Showing the parents how to select the variety of foods needed for an adequate diet.

3. Teaching the importance of the preservation of vitamin quality in foods by good marketing practices and proper preparation procedures.

4. Showing parents their responsibility in providing adequate daily needs regularly in the home.

5. Obtaining the cooperation of teachers in helping the children to learn the value of good nutrition.

REFERENCES

1. McBryde, L. C. 1953. The Diets of Louisiana Elementary School Children. M.S. Thesis, Louisiana State University.
2. McBee, M. 1950. The Hemoglobin Concentrations, Erythrocyte Counts, and Hematocrits of Selected Louisiana Elementary School Children. M.S. Thesis, Louisiana State University.
3. Food and Nutrition Board. 1953. Recommended Dietary Allowances, Revised. National Research Council Publication No. 302, Washington, D. C.
4. Food and Nutrition Board. 1948. Recommended Dietary Allowances, Revised. National Research Council Reprint and Circular Series No. 129, Washington, D. C.
5. Attaya, R. B., Terrell, E. L., and Larriviere, A. The National School Milk Program. A Survey of the Effects of the National School Milk Program on Milk Consumption in Selected Louisiana Schools and on Total Milk Consumption by School Children. Louisiana State Department of Education, Bulletin No. 819.
6. Moschette, D. S., Causey, K., Cheely, E., Dallyn, M., McBryde, L., and Patrick, R. 1952. Nutritional Status of Preadolescent Boys and Girls in Selected Areas of Louisiana. La. Agr. Exp. Sta. Tech. Bull. No. 465.

Production of Nursery and Greenhouse Crops in Louisiana

La
6307
L93b
#511

A. C. Harper, R. H. Hanchey, and M. D. Woodin

June 1957

Bulletin No. 511

Agricultural Experiment Station
Charles W. Upp, Director
Louisiana State University and
Agricultural and Mechanical College

CONTENTS

Page
Location of Production 3
Size of Commercial Operations 5
Some Characteristics of Growers and Their Operations 6
Labor Force 11
Marketing Practices 11
Value of Sales 14
Markets 16
Wholesale and Retail Selling by Growers 17
Distribution of Growers According to Sales Volume 17
Transportation 18
Problems of the Industry 18

COVER—Kurume azaleas growing under lath. Commercial producers in Louisiana have 94 acres of plant material growing under various structures and coverings referred to as lath houses.

Production of Nursery and Greenhouse Crops in Louisiana

A. C. HARPER, R. H. HANCHEY, AND M. D. WOODIN[1]

The production of nursery and greenhouse crops—commonly referred to as the horticultural specialties—has become increasingly important in the agricultural economy of Louisiana. Marketings of these crops returned approximately $3.5 million to Louisiana producers in 1955. Yet, because of the lack of factual information the important role of the horticultural specialties has been practically unnoticed by those outside the industry.

To accurately appraise the economic importance of these crops, a survey was made of the industry in 1956. All commercial producers in the state were visited and information obtained which would permit a better understanding of this relatively unknown agricultural enterprise. In addition, a questionnaire was mailed to approximately 600 small part-time producers in order to obtain information about their growing operations, which are limited to small greenhouses, home yards, vacant lots, or small field plots.

Results of the survey are reported by areas in most cases, and not as individual parish totals, in order not to reveal confidential information concerning a particular producer's operation.

LOCATION OF PRODUCTION

Parishes having commercial nursery and greenhouse production are shown as shaded areas in Figure 1. Also, the number of producers, both commercial and small part-time operators, is indicated for each parish. Small part-time producers are those concerned with growing and marketing on a very limited scale such items as bulbs, foliage plants, seed, bedding plants, liners, general nursery stock, and/or cut flowers.

Nearly every parish has a number of small growers who are producing and selling plant materials not only for the purpose of supplementing their income, but because they have found it to be interesting and stimulating as a hobby. The survey revealed that a substantial number of those reporting in this group were older people, many of whom had retired from other jobs or businesses.

---

[1] Assistant Agricultural Economist, Horticulturist, and Agricultural Economist, respectively.

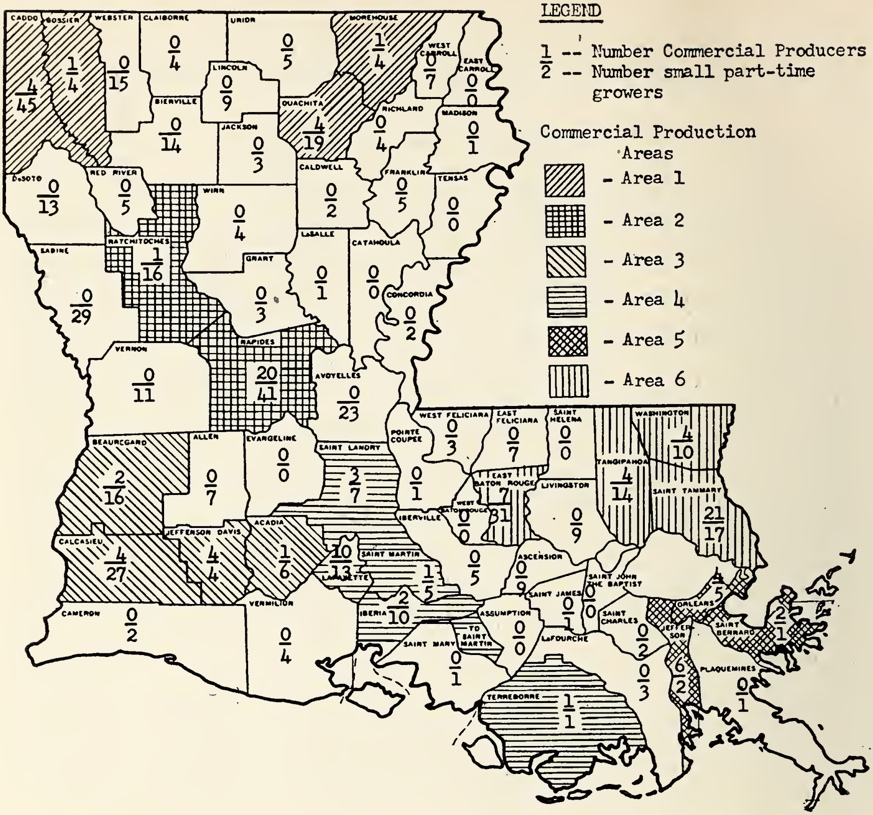


FIGURE 1.—Location and nuber of commercial and small part-time producers growing and marketing ornamental and floricultural crops, Louisiana, 1956. Commercial production is confined to 22 parishes, with the largest number of producers located in the southern part of the state. Commercial growers in Areas 4 and 6 had a total of 2,613 acres in production in 1956 and sales in 1955 with a wholesale value of $2 million.

Commercial production is confined to 22 parishes, with the largest number of producers being located in the southern part of the state. Practically all production in Areas 2, 4, and 6 (central, south central, and southeast, respectively) is limited to nursery crops or ornamental items (these are generally defined as plants grown for the purpose of replanting outdoors). Production in Area 5 is devoted almost entirely to greenhouse crops or floricultural items (these are defined as those items grown outdoors and in greenhouses for later use in homes and other buildings or for personal adornment). Producers in Areas 1 and 3 grow both nursery and greenhouse crops to about the same extent.

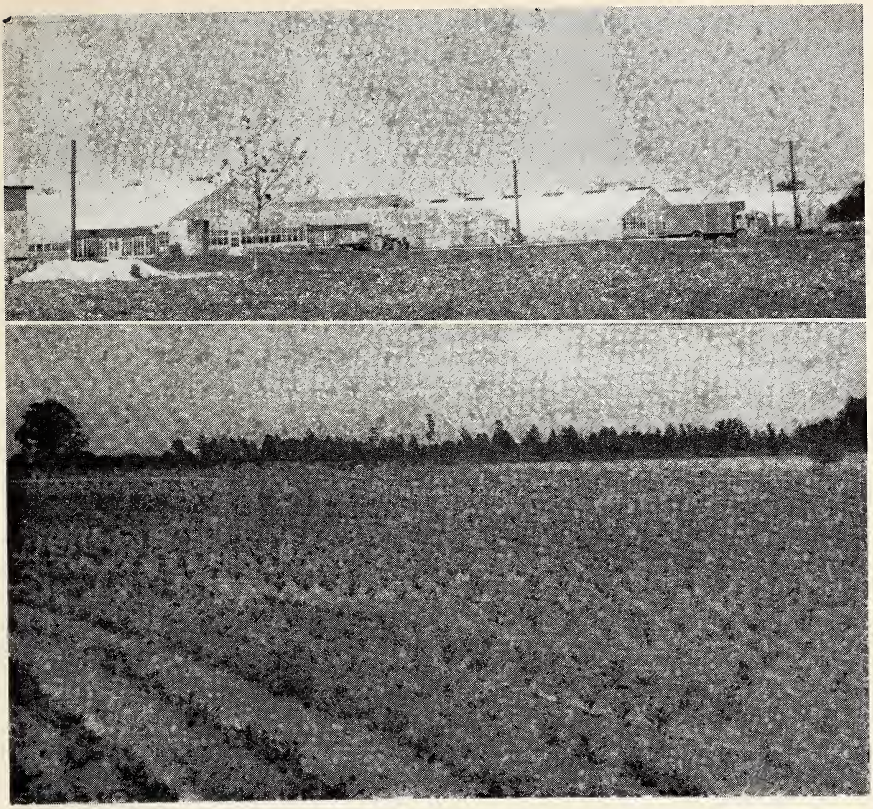


FIGURE 2.—Two types of commercial growing operations in Louisiana. Upper: Range of greenhouses used for growing floricultural crops. Greenhouse space totals 740,153 square feet in the state. Lower: A field of one-year-old holly. A majority of nursery plants are marketed after two years' growth in the field.

SIZE OF COMMERCIAL OPERATIONS

Louisiana nurserymen had the equivalent of 3,094 acres of field planted stock in 1956 (Table 1). A large part of this acreage was planted in ornamentals classified as broadleaf evergreens. A few of the common evergreen plants found in most nurseries are gardenias, ligustrums, hollies, cherry laurels, Photinias, pittosporums, abelias, azaleas, camellias, and various conifers.

Of the total planted acreage, approximately two-thirds, or 1,934 acres, are located in Area 6. Within this area St. Tammany Parish alone accounts for 1,512 acres. Most of the production in this parish is centered in the vicinity of Folsom, Abita Springs, and Covington. The next largest planting is in Area 4 with 679 acres, of which Lafayette Parish has 566. Plantings at Forest Hill and

Lecompte in Rapides Parish total approximately 300 acres, and rank third in the individual parish totals.

Lath-house area, which is used mainly for growing azaleas, camellias, container plants, forcing cut flowers, and the rooting of cuttings, is greatest in Areas 2, 4, and 6 and totals 94 acres for the state. Again, the parishes with the largest planted acreage also have the largest area under lath.

A total of 740,153 square feet of greenhouse space is used in the production of Louisiana's nursery and greenhouse crops. Most nurserymen have a greenhouse structure which is used for germinating seed and rooting cuttings, but the greatest use of greenhouse area is made by producers of floricultural crops as in Area 5. Floricultural items produced in the state include foliage plants, cut flowers, and flowering pot plants. The major foliage plants are philodendrons, Pothos, rubber plants, diffenbachias, peperomias, Chinese evergreens, caladiums, sansevieria, and jade plants. Chrysanthemums, snapdragons, gladiolus, and lilies account for the majority of locally grown cut flowers. Gloxinias, Saintpaulias, azaleas, begonias, chrysanthemums, hydrangeas, lilies, and poinsettias are the major flowering pot plants.

TABLE 1.—Acreage and Facilities Used in Production of Nursery and Greenhouse Crops, Louisiana, 1956

Areas of Production*	Nursery Crops	Greenhouse Structures	Lath-house Area	Cold and/or Hot Frames
	(Acres)	(Sq. Ft.)	(Acres)	(Sq. Ft.)
Area 1	67	56,686	4.75	15,340
Area 2	327	21,262	11.75	7,380
Area 3	69	19,279	1.25	2,136
Area 4	679	49,053	22.75	200
Area 5	18	354,791	1.25	41,970
Area 6	1,934	239,082	52.25	178,310
State Total	3,094	740,153	94.00	245,336

*Area 1 includes the parishes of Caddo, Bossier, Morehouse, and Ouachita; Area 2 includes Natchitoches and Rapides; Area 3 includes Beauregard, Calcasieu, Jefferson Davis, and Acadia; Area 4 includes St. Landry, St. Martin, Iberia, Terrebonne, and Lafayette; Area 5 includes Jefferson, Orleans, and St. Bernard; and Area 6 includes Washington, Tangipahoa, St. Tammany, and East Baton Rouge.

SOME CHARACTERISTICS OF GROWERS AND THEIR OPERATIONS

The number of years that growers have been in the nursery and greenhouse business is indicated in Table 2. Although approximately 25 per cent have been in business for more than 20 years, the industry as a whole is relatively new. Sixty-five of the

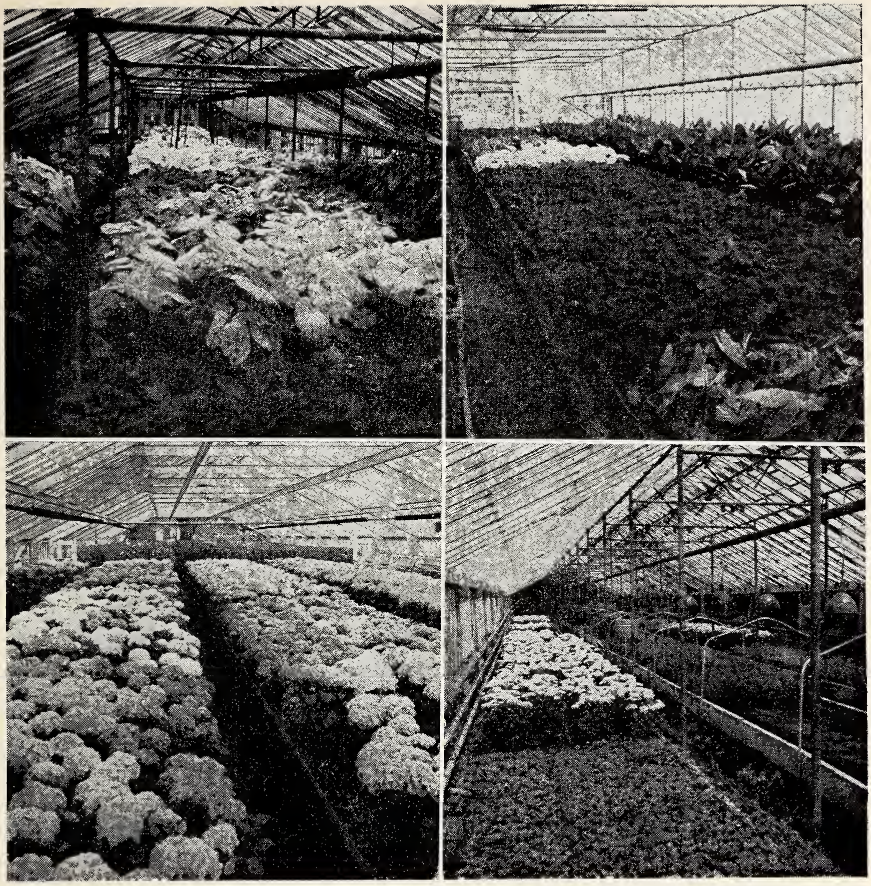


FIGURE 3.—Greenhouse produced crops. This type of operation accounted for about one-third of the $3.5 million wholesale marketings by the industry in 1955. Upper: Foliage plants. Lower: Hydrangeas grown for Easter and chrysanthemums in various stages of development.

107 commercial producers, or about 61 per cent, started their growing operation after 1940, with approximately 16 per cent of the total starting since 1950. Of the 3,094 acres in production, 2,408 acres, or 78 per cent of the total, was being operated by individuals in the industry 20 years or less. In general, the growers who have entered the business in the last 10 years are expanding acreage more rapidly than the older growers. Many older growers have already reached what they consider to be their optimum size and for various reasons do not wish to expand further.

Type of ownership of the nursery and greenhouse businesses in the state falls into several categories. Eighty-eight producers,

TABLE 2.—Number and Per Cent of Producers in Nursery and Greenhouse Business for Specified Number of Years, Louisiana, 1956

Years Grower Has Been in Business	Number of Growers	Per Cent of Growers
5 or less	17	15.9
6-10	31	29.0
11-15	17	15.9
16-20	15	14.0
20 or more	27	25.2
Total	107	100.0

or 82 per cent, reported individual or private ownership. Of the remainder, 12 per cent indicated they were operating under a partnership agreement, 4 per cent as corporations, and 2 per cent as estates.

As a rule most Louisiana nurserymen developed their businesses gradually and did not start on a large-scale basis. In the Forest Hill-Lecompte area in Rapides Parish and the Folsom area in St. Tammany Parish, particularly, the pattern of development is very similar. Nearly every grower in these areas worked as a hired laborer for older nurserymen and began his own operation after acquiring experience and a limited amount of capital. In some cases individuals were encouraged and financially assisted by their employer in getting started.

The development of greenhouse operations varies somewhat from that of the nursery industry. Most producers of floricultural products have been in the business for a number of years, and have maintained the operation on a family basis. The greenhouses usually are still operated by the original owners or by members of the immediate family. The entrance of new growers into this industry is not as common as in the case of nurseries.

Of the 107 commercial producers, 80 reported that the production of general nursery stock accounted for all or the main part of their growing operation. Approximately 25 per cent of the nurserymen were producing foliage plants, cut flowers, bedding plants, and/or liners in addition to their field planted acreage. The remaining 27 commercial producers were engaged in the production of floricultural crops only. About two-thirds of these reported the growing of a combination of cut flowers, flowering pot plants, foliage plants, and/or bedding plants, while the others were specifically engaged in the production of foliage and bedding plants, cut flowers, or ferns.

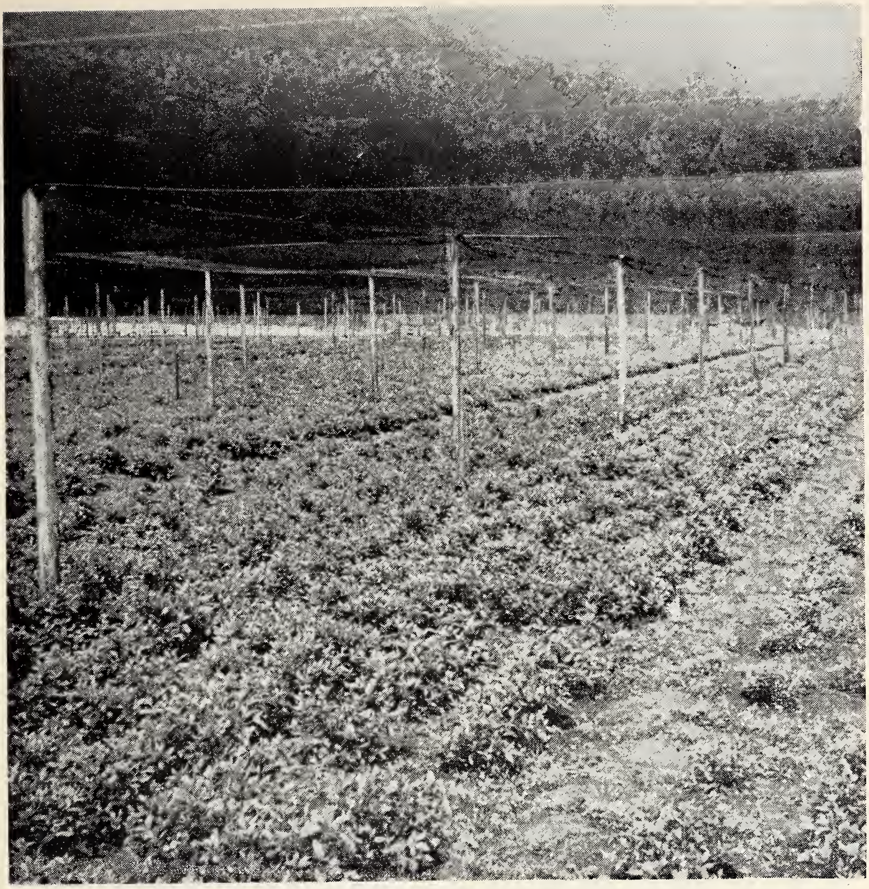


FIGURE 4.—Kurume azaleas growing under plastic cloth. Part of an 18-acre tract in St. Tammany Parish.

The planting and growing of ornamentals in containers is increasing in importance among Louisiana nurserymen. Not all nurserymen are in agreement as to the potential of container-grown plants; however, a few have made rather large investments in this type of growing operation during the past few years. Some growers indicate that certain plants do very well in containers. The fact that container plants require a small growing area, can be marketed the year around, and require less machinery and labor for production are some of the reasons expressed by growers in favor of a container operation. However, watering, fertilizing, and soil mixtures are a few of the problems growers were confronted with before finding the best method for producing a marketable

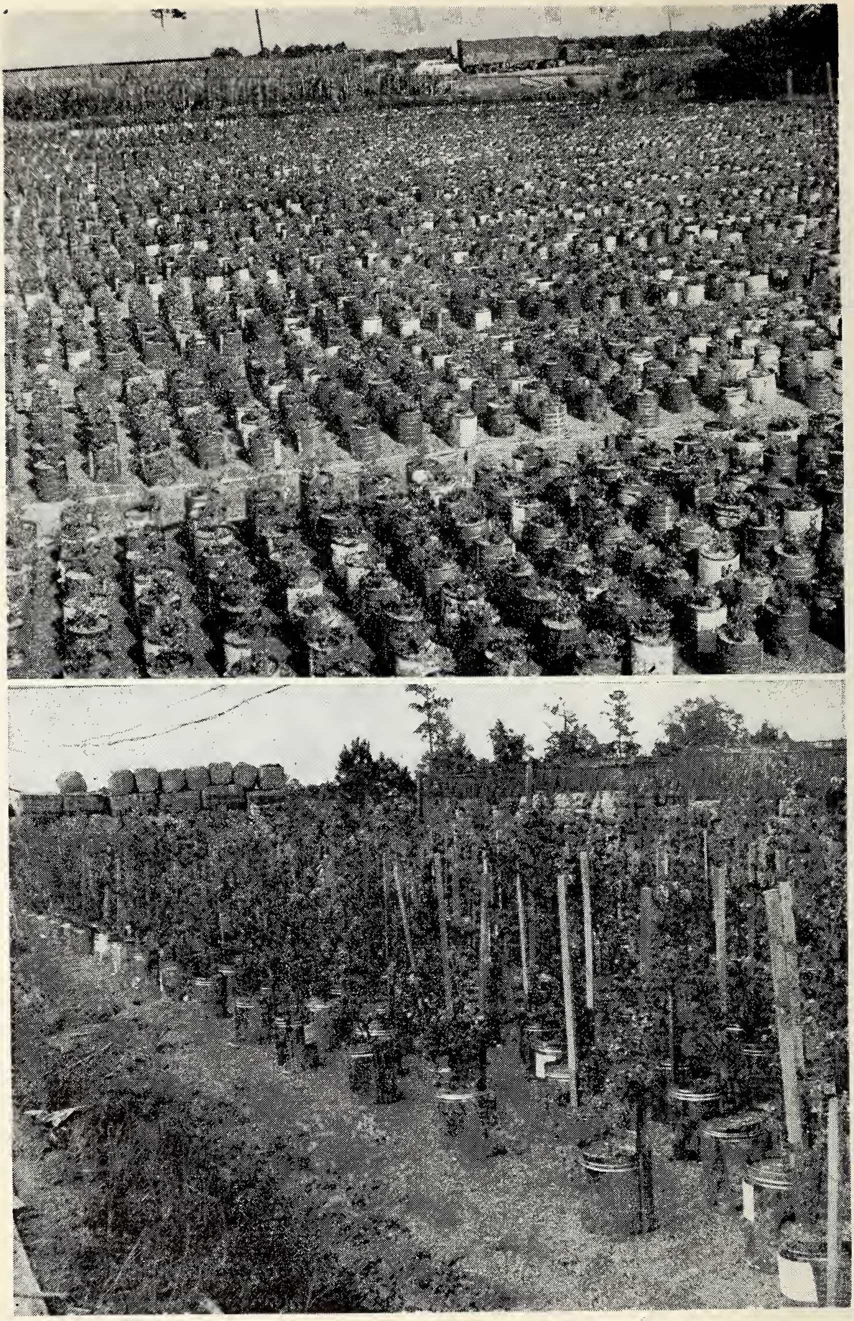


FIGURE 5.—Ornamentals growing in containers. This type of growing operation is increasing in importance among Louisiana nurserymen.

container-grown plant. Further research and experience should provide better answers to questions now being asked about container-growing practices.

LABOR FORCE

Expenditures for labor represent the largest individual cost in the production of ornamental and floricultural crops. The production of these crops does not lend itself to as great a use of labor saving machinery as is the case with some of the other agricultural enterprises. Planting, hoeing, pruning, and the balling and burlapping of plants in the digging season are some of the operations that require large expenditures for labor by nurserymen.

The total labor force employed by producers for the production of nursery and greenhouse crops in 1956 was equivalent to 691 full-time employees (Table 3). This total represents 554 full-time employees and 436 seasonal workers who were hired to assist in various operations throughout the year. As shown in Table 3 the number of persons hired by greenhouse operators (Area 5) does not vary too much during the year. Because of the need for experienced workers in all phases of floricultural production, growers have found it necessary to plan their operations so that they can offer year-round employment to their workers rather than depend on untrained seasonal labor.

MARKETING PRACTICES

Growers transplant year-old rooted cuttings or seedlings, commonly called lining-out stock or liners, to the field for further growing and hardening. As a rule a majority of these plants are left in the field for two years before they are marketed; however, some selective selling of larger plants is done after one year's

TABLE 3.—Labor Force: Number of Full-time and Seasonal Workers Hired by Louisiana Nursery and Greenhouse Operators, 1956

Areas of Production*	Number Employed Full-time	Number Employed Seasonally	Equivalent Full-time Employees
Area 1	29	47	40
Area 2	39	69	58
Area 3	20	15	23
Area 4	108	72	130
Area 5	84	10	87
Area 6	274	223	353
State Total	554	436	691

*For parishes in each area see Table 1 and Figure 1.

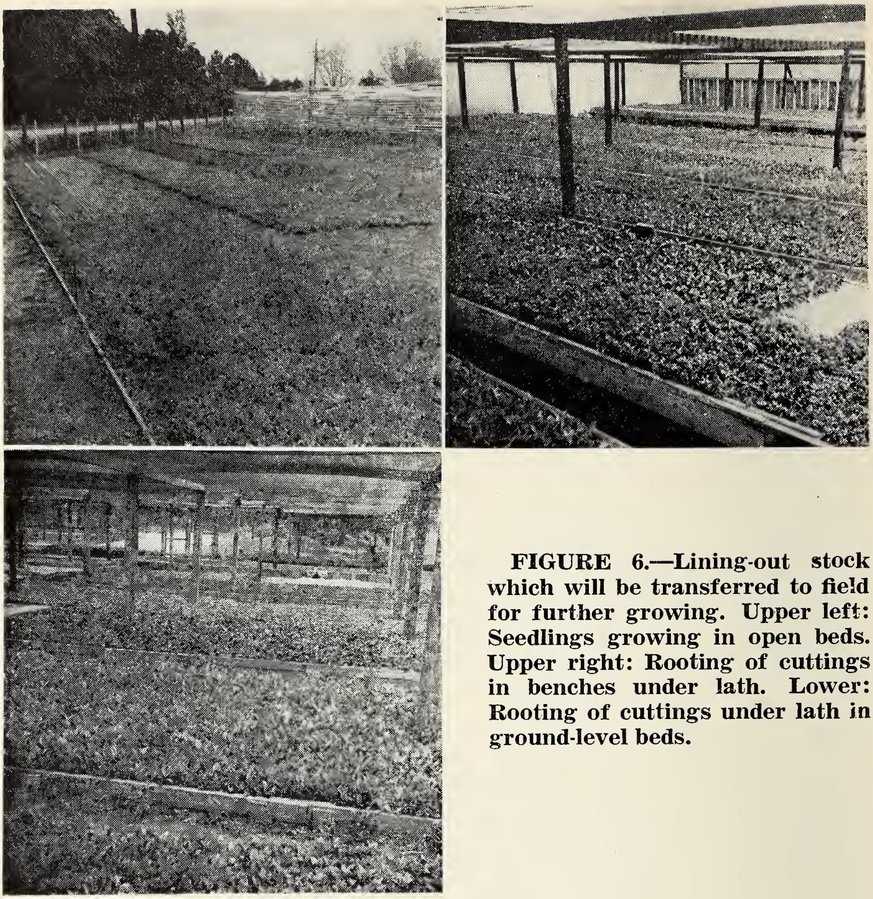


FIGURE 6.—Lining-out stock which will be transferred to field for further growing. Upper left: Seedlings growing in open beds. Upper right: Rooting of cuttings in benches under lath. Lower: Rooting of cuttings under lath in ground-level beds.

growth for certain varieties. The period from October through April is the major digging or marketing season for field nursery plants.

In the case of floricultural items, foliage plants are marketed the year around, while the production of most cut flowers and holiday plants must be timed for a specific date. Nearly all Louisiana cut flower and flowering pot plant operations are scheduled so that these items are ready for marketing at Easter, Mother's Day, All Saints' Day, and/or the Christmas holidays.

Growers use several different advertising media in making buyer contacts. Greenhouse operators and nurserymen located near urban centers who market most of their crop at retail use radio, newspaper, and some television advertising. Wholesale growers, particularly nurserymen, attempt to contact buyers

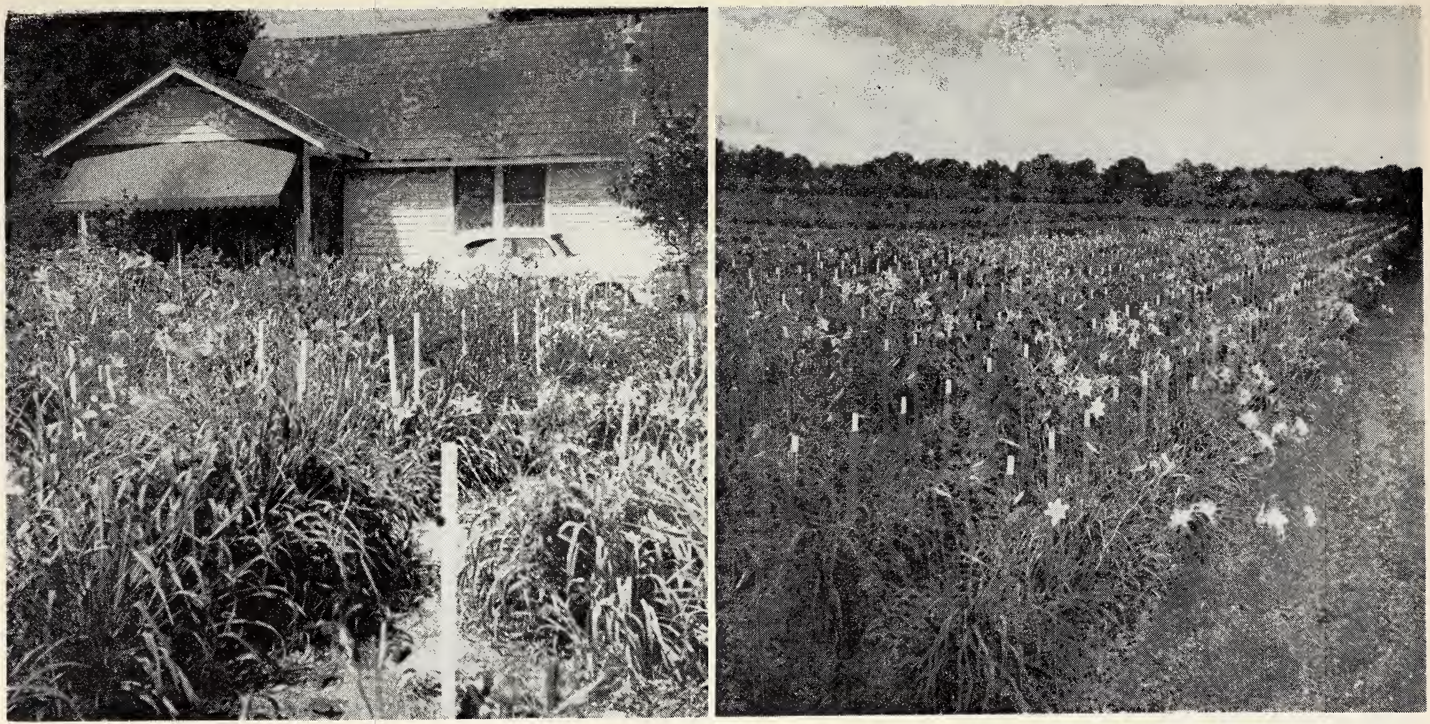


FIGURE 7.—Small part-time grower operation, and L. S. U. experimental plots. Left: Growing of daylilies on a vacant lot by a small part-time producer. The value of sales by this group of producers amounted to approximately $211,000 in 1955. Right: View of the L. S. U. Horticultural Research plot where a large number of daylily seedlings are being tested. Iris, gladiolus, hibiscus, amaryllis and Saintpaulia also comprise a part of the ornamental breeding program being conducted at L. S. U. New seedlings of special merit are released to commercial growers for increasing.

through the distribution of small catalogues or folders which state the wholesale price, terms and conditions of sale, and description of plant material for sale. Some advertising is done in trade magazines. Nurserymen also book orders at state and out-of-state nursery conventions where plant materials of individual growers are displayed for inspection by prospective buyers.

All plant materials sold in the state must be inspected and certified by the Division of Entomology, Louisiana Department of Agriculture and Immigration, as being free of diseases and insects. However, there are no Federal or State grades and standards for nursery stock. Generally, the practices used by Louisiana nurserymen in determining the price of stock offered for sale are very similar. As a rule, plants are priced on the basis of height or spread. Plants are usually advertised at several different sizes and prices, with a higher price being quoted for each additional one-half or one foot of growth. The age, or number of years the plant has been field grown, is also an important factor in determining the selling price for certain varieties.

Practically all nurserymen are members of the Louisiana Association of Nurserymen, Inc., Southern Nurserymen's Association, and/or the American Association of Nurserymen. However, other than the annual nursery convention, there is no organized effort on the part of growers to cooperatively advertise and promote Louisiana's nursery industry.

VALUE OF SALES

The wholesale value of sales by all producers of nursery and greenhouse crops, including the small part-time growers, amounted to $3,449,854 in 1955 (Table 4). Approximately two-thirds of this total was accounted for by the sale of ornamental crops and the remaining one-third by floricultural sales.

Growers in Area 6, which includes Washington, Tangipahoa, St. Tammany, and East Baton Rouge parishes, had sales in 1955 with a wholesale value of $1.5 million—almost one-half of the state total. St. Tammany, the leading nursery area, ranked first in sales on a parish basis with a total of $980,000, Lafayette second with sales of $403,000, and Rapides third. Sale of floricultural products was greatest in Jefferson Parish, where the wholesale value of these items marketed by growers was approximately $300,000. The next greatest sales total was reported by greenhouse operators in Orleans Parish. St. Bernard Parish ranked third.

TABLE 4.—Wholesale Value of Nursery and Greenhouse Crops Sold by Growers, Louisiana, 1955

Areas of Production*	Number of Growers	Wholesale Value of Grower Sales
		(Dollars)
Area 1	10	128,907
Area 2	21	294,800
Area 3	11	87,525
Area 4	17	531,537
Area 5	12	696,119
Area 6	36	1,500,300
Other Small Part-time Producers	513	210,666
State Total	620	$3,449,854

*For parishes in each area see Table 1 and Figure 1.

When compared to some other crops grown and sold in Louisiana, the horticultural specialties are in a very favorable position from the standpoint of gross dollar return to producers (Table 5). The $3.5 million ornamental and floricultural sales total was one-half as great as the income received by growers from the marketing of sweet potatoes—a crop that is nationally advertised and publicized. The total is only a little less than the income returned to growers for the 1955 strawberry crop. The total exceeds the income received from the sale of all vegetable crops, including such crops as cabbage, snap beans, shallots, green peppers, cucumbers, and commercial vegetables for processing. However, it should be pointed out that the 1955 income from both the sweet potato and strawberry crop was somewhat below the normal return and a comparison of the income from nursery and greenhouse crops in most years would show a greater difference.

TABLE 5.—Comparison of Income from Sale of Ornamental and Floricultural Crops with Incomes Received from Other Selected Crops Grown and Marketed in Louisiana, 1955

Crops	Income from Sales
	(Dollars)
Ornamental & Floricultural	3,449,854
Sweet Potatoes	6,999,000
Strawberries	3,988,000
Oranges	479,000
All Vegetable Crops, including Commercial Vegetables for Processing	2,995,000

Source: Other Crops—Unpublished data compiled by J. P. Montgomery from reports issued by AMS, U. S. D. A.

MARKETS

During 1955 Louisiana-grown nursery and/or greenhouse crops moved into every state in the nation. A comparison of Louisiana with other states as a market for these crops shows that approximately 46 per cent of the total income received by growers was accounted for by sales to Louisiana buyers while 54 per cent was from sales to out-of-state buyers (Table 6).

A further breakdown of sales as to kinds of plant material sold indicates that nurserymen producing ornamentals depend to a larger extent on other states as a market than do producers of floricultural items. Of the items classified as ornamentals, approximately 70 per cent of the total sales were made to out-of-state markets. Sales by growers located near urban centers accounted for most of the crop that was sold in the state. As indicated in Table 6, a large part of the sales by nurserymen in the main production centers in Rapides, Lafayette, and St. Tammany parishes, located in Areas 2, 4, and 6 respectively, was made to buyers from other states. Some of the states considered the best markets for ornamentals year after year are Texas, Oklahoma, Arkansas, Mississippi, Alabama, Georgia, South Carolina, and Tennessee.

TABLE 6.—Markets: Comparison of Louisiana with Other States as a Market for Louisiana Produced Nursery and Greenhouse Crops, 1955

Areas of Production*	Sales in			
	Louisiana	Other States	Louisiana	Other States
	Dollars		Per Cent	
Area 1	114,245	14,662	88.6	11.4
Area 2	100,005	194,795	33.9	66.1
Area 3	62,763	24,762	71.7	28.3
Area 4	123,401	408,136	23.2	76.8
Area 5	530,510	165,609	76.2	23.8
Area 6	553,160	947,140	36.9	63.1
State Total	$1,484,084	$1,755,104	45.8	54.2

*For parishes in each area see Table 1 and Figure 1.

The situation was reversed in the case of floricultural products, since about 77 per cent of growers' production was sold in Louisiana and only 23 per cent moved to other states. Practically all production of these crops is centered around New Orleans, which also is the main market, particularly for cut flowers. Foliage plants are the principal floricultural items grown and shipped to out-of-state markets.

WHOLESALE AND RETAIL SELLING BY GROWERS

Of the $3,239,188 received by commercial growers in 1955, approximately 75 per cent of the total was accounted for by sales to wholesale buyers (Table 7). Retail sales, based on a wholesale crop value, amounted to about $800,000, or 25 per cent of the total.

As a result of a smaller volume of production than in other areas and nearness to large population centers, growers in Areas 1 and 3 have found it possible to market most of their crop at retail through their own sales yard or flower shop. In Area 5, which includes New Orleans, 45 per cent of the floricultural production is sold at retail, since a number of the producers sell through their own florist shops in addition to moving part of their crop through wholesale channels.

TABLE 7.—Trade Outlets: Comparison of Wholesale and Retail Sales of Nursery and Greenhouse Crops, Louisiana, 1955

Areas of Production*	Wholesale	Retail	Wholesale	Retail
	Dollars		Per Cent	
Area 1	20,961	107,946	16.3	83.7
Area 2	239,610	55,190	81.3	18.7
Area 3	30,843	56,682	35.2	64.8
Area 4	454,182	77,355	85.4	14.6
Area 5	382,007	314,112	54.9	45.1
Area 6	1,311,830	188,470	87.4	12.6
State Total	$2,439,433	$799,755	75.3	24.7

*For parishes in each area see Table 1 and Figure 1.

Practically all production marketed in Areas 2, 4, and 6 moves through wholesale trade outlets. The fact that most operations are relatively large and are located in rural areas accounts for the small volume sold at retail. A few producers on main highways maintain retail sales yards, but in most cases the large growers market their crops through wholesale outlets only.

DISTRIBUTION OF GROWERS ACCORDING TO SALES VOLUME

As indicated in Table 8, 36 producers, or about 34 per cent of the total number of commercial operators, had sales in 1955 of more than $25,000. This group accounted for slightly over $2.5 million of the marketings, or 79 per cent of the total sales.

TABLE 8.—Number of Nursery and Greenhouse Operators with Sales of Specified Value, Louisiana, 1955

Value of Sales	Number of Growers	Dollar Sales by Each Group	Per Cent of Total Sales by Each Group
Below $10,000	38	168,800	5.2
10,000-25,000	33	502,769	15.5
Over 25,000	36	2,567,619	79.3
State Total	107	$3,239,188	100.0

Of the remaining producers, 31 per cent had sales ranging from $10,000 to $20,000, and 35 per cent reported sales of less than $10,000. As expected, many of those reporting the smaller 1955 sales are relatively new in the industry. However, it is also this group which will play an increasingly important role in future marketings because of current expansion programs underway.

TRANSPORTATION

Trucks represent the most important mode of transportation used in moving Louisiana nursery and greenhouse crops to the various markets in the United States. A small part of the crop is shipped by parcel post, rail, and air express. Most of the items moving by these carriers are relatively compact and light and include such materials as bedding plants, liners, flowers, and small nursery stock.

A number of nurserymen operate their own trucks for delivering orders to local and out-of-state markets. However, a few growers maintain no trucks at all, but will secure a public carrier for delivering the plant material if requested to do so by the buyer. In many instances buyers furnish their own trucks for transporting their purchases.

PROBLEMS OF THE INDUSTRY

All growers of nursery and greenhouse crops face about the same production problems. For nurserymen, the decision as to what and how much of each kind of plant to produce is rather difficult since there is an interval of about two years between time of planting and time of selling. During this time the market demand may change. Greenhouse operators, especially those pro-

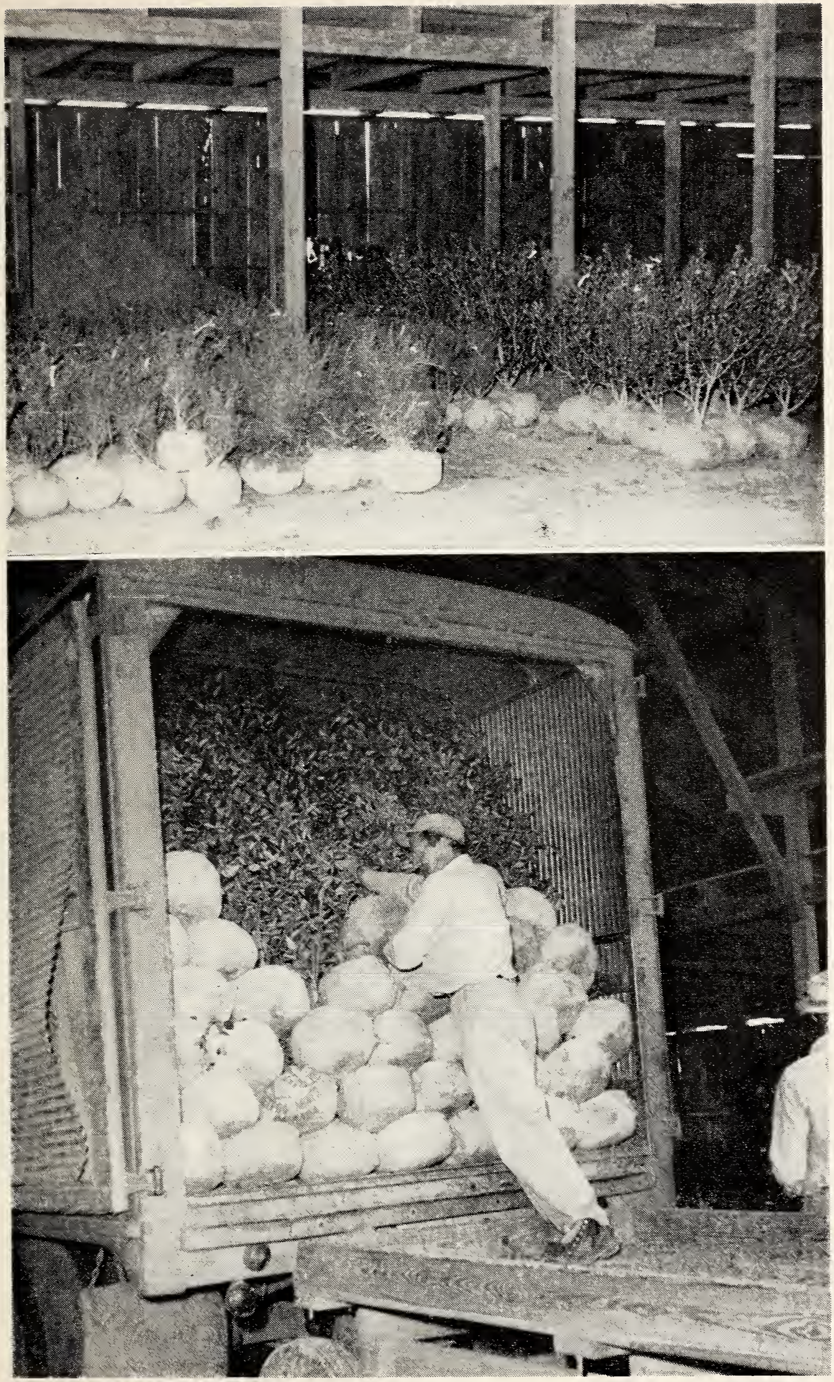


FIGURE 8.—Field-grown nursery stock moving to market. Upper: Balled and burlapped plants ready for loading. Lower: Loading Louisiana nursery stock in truck for shipment. Trucks represent the most important mode of transportation used in moving Louisiana plant materials to the various markets in the United States.

ducing flowers, must work out definite time schedules so that their crop will be ready to market at the various holidays during the year. The problems of propagation and insect and disease control are ever present for all producers.

Perhaps the greatest problem in the industry is that of labor. Faced with a decreasing farm population, producers are finding it more and more difficult to obtain an adequate labor supply, particularly experienced workers.

The dry weather that has been prevalent for the past few years has hampered the production of nursery crops. Loss of plants and slow growth, which results in lower quality plants, are some of the effects of the lack of normal rainfall. Nurserymen, as other Louisiana farmers, are faced with the decision as to whether it would be economical for them to install irrigation systems. At the present time approximately 500 acres are being irrigated by growers.

Growers cite the need for additional experimental work and technical assistance as is provided for other crops produced in the state. Recommendations of new varieties to plant in this area, a fire ant eradication program, help in determining the best methods for growing and marketing container-grown plants, and information about new insecticides, fungicides, and herbicides are some of the areas in which producers feel that assistance would be beneficial.

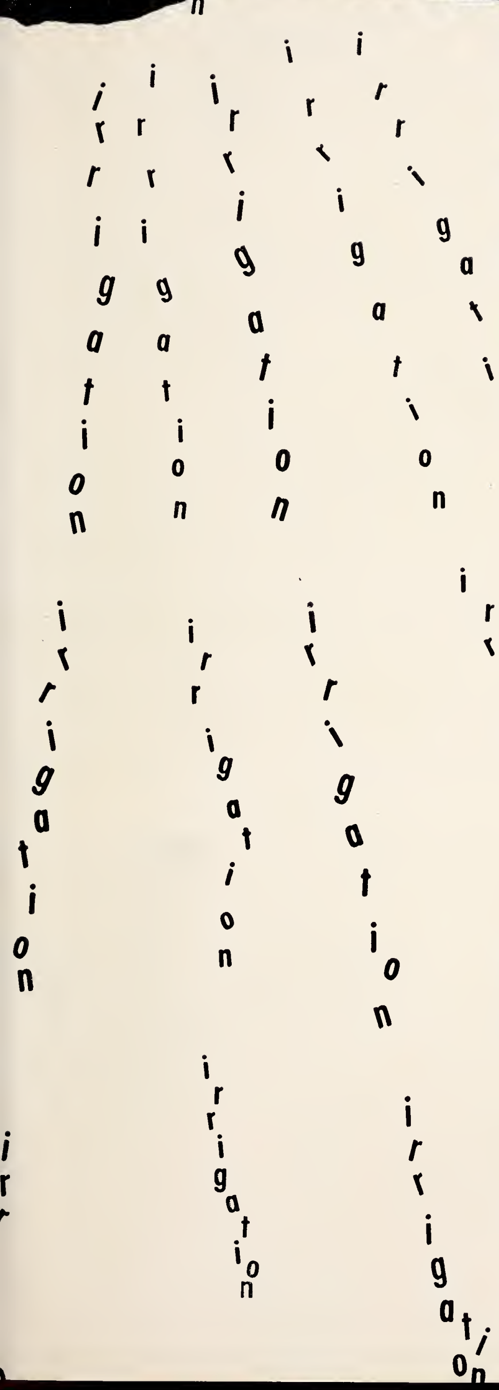
Producers realize that many of the items they grow are mainly luxury products. But with rising personal incomes, a continued high rate of new home construction, and the increased use of ornamental and floricultural products by public institutions and businesses for the beautification of grounds and buildings, they feel that the demand outlook for their industry is very favorable.

In the face of an expanding market, less attention has been given to marketing and merchandising problems than would have been the case if demand conditions were less favorable. As production expands, more emphasis will have to be given the marketing aspects of the industry. Already there appear to be opportunities to increase net returns by doing a better marketing job through demand stimulation, expanded markets, better packaging and merchandising, and the adoption of proven modern marketing techniques by nursery and greenhouse businesses.

Bulletin no. 512
February 1958

Irrigation Costs and Returns

for Cotton in the Mississippi and Red River Delta Areas of Louisiana



By Gene D. Sullivan and
Fred H. Wiegmann

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University
and Agricultural and
Mechanical College

FOREWORD

The information in this bulletin is designed to help farmers make decisions concerning irrigation. It is based on a survey of 71 farms irrigating cotton in 1956. The analysis shows that irrigation was very profitable on the 71 farms surveyed in 1956, *average net* returns varying from $45 to about $75 per acre. The year 1956 was relatively dry during the production season.

The bulletin presents information on the investment required for various acreages, the costs of operating a system, and returns from irrigation. The data shown are in the form of averages. Individual farms had costs, yields, and returns both higher and lower than those shown. The data are shown separately for flooding and sprinkling where differences were large and reliable enough to justify doing so. Otherwise, the data were combined as averages for the two systems.

"Bench mark" data are presented for use in estimating "expected" costs of irrigation.

TABLE OF CONTENTS

Page
I. INTRODUCTION 4
Source of Data 5
Method of Analysis and Presentation 6
Rainfall, Irrigation, and Yields 7
II. INVESTMENT REQUIREMENTS 8
Initial Investment in Sprinkler and Flooding Systems . . 8
Source of Water and Investment 10
Total Investment 8
Source of Water and Investment 10
Investment in Land Preparation 11
Investment in Equipment 13
    Pipe 13
    Siphons 16
    Sprinklers 16
    Culverts 16
    "Other" Equipment 16
III. COSTS OF IRRIGATION 16
Fixed Cost 17
    Depreciation 17
    Interest 18
Operating Costs 19
    Labor Hours 19
    Labor Cost 20
    Power, Lubrication, and Repair Costs 21
IV. ESTIMATING "EXPECTED COSTS" OF IRRIGATION 22
V. COST OF IRRIGATING COTTON—1956 23
VI. THE RETURNS TO IRRIGATION—1956 25
Yield Increase 26
Gross Added Returns 27
Net Added Returns 27
VII. SUMMARY AND CONCLUSIONS 29
Summary 29
Conclusions 31

Irrigation Costs and Returns for Cotton in the Mississippi and Red River Delta Areas of Louisiana

GENE D. SULLIVAN AND FRED H. WIEGMANN*

I. INTRODUCTION

Irrigation is a relatively new but growing practice in cotton production in Louisiana. According to the census of 1954 there were 3,682 acres of land irrigated in 1949 in 27 North Louisiana parishes. By 1954 this had increase to 33,027 acres.[1] Most of the irrigated acreage was cotton. Most of the irrigation was in the Red River and Mississippi Delta Areas. About 8 percent of the irrigated acreage was in the Hill Parishes.

As interest in irrigation increases, the need for information concerning the practice also increases. This is true of both agronomic and economic data. The decision to invest or not to invest in an irrigation system is an important one on farms where irrigation is possible. Most farmers have a limited amount of money for productive purposes and many alternative ways in which it may be used. Investing in an irrigation system often means some other investment must be postponed or, possibly, done without.

Whether or not to install an irrigation system, the kind to use, and many related decisions must be determined for the individual farm. Information from farms already using irrigation, however, may be helpful in making such decisions. The research reported in this publication is an economic analysis of data obtained from a group of 71 farmers irrigating cotton in North Louisiana. The purpose of the study was to determine the costs and returns due to irrigating cotton under Louisiana conditions. This kind of information has been very limited. The data following should prove helpful as "bench mark" material for the use of farmers, and those who work with farmers, when considering irrigation.

---

*Department of Agricultural Economics. The authors are indebted to Joe R. Campbell, J. N. Efferson, and M. D. Woodin for critical review of the manuscript. Errors are, of course, the responsibility of the authors.

[1] These figures do not include "land used solely for pasture and grazing," 1954 Census of Agriculture for Louisiana, p. XIX.

Source of Data

The data were obtained from cotton farmers in Catahoula, Franklin, Richland, Ouachita, and Caldwell parishes in the Mississippi Delta Area and in Caddo and Bossier parishes in the Red River Delta Area, as shown in Figure 1. The cost information was obtained by interviewing farmers during August 1956, when most farmers had finished irrigating for the season. The information on yields was obtained partly by mailed questionnaire and partly by personal interview in January of 1957, after all farmers had finished harvesting the 1956 crop.

Only a small proportion of farmers are using irrigation at the present time. The 71 farmers represent the major portion of those irrigating in some of the parishes. Farms were selected from a list, stratified by acreage, to include both sprinkling and flooding systems and a wide range in the number of acres irrigated under each system.

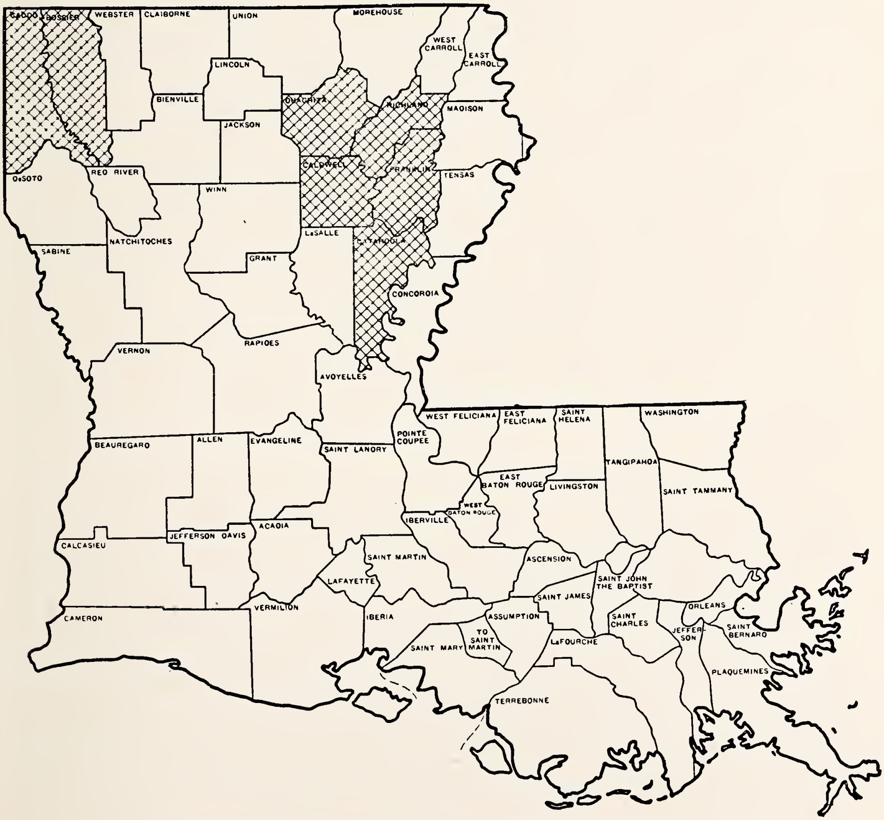


FIGURE 1.—Parishes Included in the Sample.

The farms ranged in size from 13 to 283 acres of irrigated cotton. Most of the farms also grew cotton which they did not irrigate. This provided a comparison of cotton yields from irrigated and non-irrigated plots grown under similar conditions except for the additional water.

Of the 71 farmers contacted 39 used flooding systems and 32 used sprinkler systems.

Method of Analysis and Presentation

The data in the tables following are averages based on straight line regressions. That is, straight lines (Figure 5, for example) were mathematically fitted to the data in terms of totals (total investment, total hours of labor, total cost, etc.). A point on a line represents an average of a total from the available data, for a particular acreage. Data for individual farms fall above and below the average. The "per acre" averages are obtained by simply dividing an average total by the number of acres with which it is associated. In most cases the data for sprinkling and flooding are combined. For some items, where differences were sufficiently large and reliable, the data are presented separately for the two systems.

The cost data are shown in three parts. In Part III costs are shown separately for various cost items (investment, pipe, labor, etc.). These costs were estimated separately (1) in order to determine their relationship to one another and to the number of acres irrigated and (2) so that the estimates could be used later (in Part IV) as a basis for determining "expected" or "bench mark" costs of irrigation for a season. To do this it is necessary to separate fixed and variable costs, since total variable costs (labor, power, etc.) depend on the number of irrigations while total fixed costs (depreciation, interest) do not.

Part IV presents cost data in a form that should be useful for "bench mark" purposes in estimating the cost of irrigation as related to the number of irrigations expected. The method of making such estimates is illustrated, using data based on Part III.

In Part V the actual costs of irrigation are shown for the 71 farms for 1956. These costs are not on a per irrigation basis. They simply show what total and per acre costs of irrigation were during 1956. These data lay the groundwork for determining whether irrigation on the 71 farms was profitable in 1956. The cost data and information on dollar returns are combined in Part VI to yield an average of actual *net* returns to irrigation for the 1956 cotton crop on the 71 farms in the study.

Rainfall, Irrigation, and Yields

An irrigation system in a humid area can only supplement rainfall. Irrigation may be thought of both as a yield increasing practice and as insurance against untimely droughts. Assuming proper operation of the system, the relative profitability from irrigation in different years will depend on the amount and distribution of rainfall. In a dry year irrigation can be highly profitable. Even in a wet year it can prove profitable if sufficient rainfall does not come at the right times.

The long-time average rainfall for Louisiana is about 55.5 inches. The weather in 1956 was generally warmer and drier than average. Rainfall was subnormal at most reporting weather stations, with the deficiencies increasing from east to west. The rainfall data reported below were taken from the annual summary of *Climatological Data* for 1956. They show the deviations from average rainfall for the particular stations in Northeast and Northwest Louisiana in 1956.

	May	June	July	August
Northeast Louisiana				
Bastrop	— 2.07	— 2.89	— .97	— .80
Lake Providence	— 1.36	+ .03	+ 1.10	+ .56
Tallulah	— 2.20	+ .02	— 1.08	+ .08
Monroe	— 3.35	+ 1.32	— 1.10	— .43
Winnsboro	— .40	— 2.21	— 1.86	+ 2.74
St. Joseph	+ .43	— .51	— 1.80	— 4.29
Jonesville	— 2.88	— 1.40	— 3.66	— 1.99
Northwest Louisiana				
Plain Dealing	— 1.38	+ .52	— 3.75	+ .91
Minden	— .49	— .27	— 3.09	+ .84
Natchitoches	— 2.86	+ 1.08	— 3.47	— 2.17
Shreveport	— .70	+ .47	— 3.40	— .12

The stations shown are those with long-time records which permit estimates of deviation from average. They are in the two areas in which data for this study were obtained. Rainfall is generally much below average for the months and stations. Shreveport reported the driest July on record.

With even poorer moisture conditions the yields attributable to irrigation reported in this bulletin might have been higher. Under better moisture conditions they would probably have been lower. In the latter case, net dollar returns also would likely have been lower.

II. INVESTMENT REQUIREMENTS

The investment in an irrigation system includes such things as land leveling, the construction of ditches, ponds, reservoirs, and dams, and the installation of wells, pipe, pumps, motors, hose, and culverts. All of these items are not necessary for any one irrigation system. Factors determining which items will be necessary for a given system include the type of system to be used (whether sprinkler or flooding), the source of water, slope of land, distance from source to application point, and similar factors.

Initial Investment in Sprinkler and Flooding Systems

The basic differences between flooding and sprinkling lead to obvious differences in investment. These are later reflected in fixed costs (interest and depreciation charges).

The items responsible for most of the difference in the investment required for sprinkler and flooding systems are pipe and land leveling. The installation of a sprinkler system requires no land leveling, whereas this generally makes up a major portion of the investment in flooding systems. Major investment in pipe is usually not a requirement where flooding systems are used, although some use pipe rather than open ditches to conduct water from the source to the point of application. Sprinkler systems require a major investment in the pipe and sprinklers which make up the sprinkler system proper, even for small acreages.

Total Investment

The total dollar investment in either type of irrigation system depends primarily on the number of acres it is designed to cover and the source of water that is to be used.

Table 1 shows an average of the total investment requirement for sprinkler and flooding systems for various acreages on the farms surveyed in this study. From these data it can be seen that the average total investment requirement for sprinkler systems exceeded that for flooding systems at the small acreages but this difference decreased as the acreage irrigated increased.

With each 30-acre increase in size the average investment requirement for sprinkler systems increased about $882, while flooding systems required an additional investment of about $1,452 for the same increase in size. Though sprinkler systems require a high beginning investment on small acreages, they can be used over more acres without a proportionate increase in investment. For example, a sprinkler system being used to irrigate 30 acres of cotton may be expanded to 40 acres of cotton with a relatively small additional expenditure. When a flooding system is used on land requiring level-

TABLE 1.—Average Total Investment and Investment per Acre on 71 Farms Irrigating Cotton, North Louisiana, 1956

Number of acres irrigated	Investment			
	Total		Per acre	
	Sprinkler	Flooding	Sprinkler	Flooding
30	$ 5,949	$ 2,256	$198.30	$75.19
60	6,831	3,708	113.86	61.79
90	7,714	5,160	85.71	57.33
120	8,596	6,612	71.63	55.10
150	9,479	8,064	63.19	53.76
180	10,361	9,516	57.56	52.87
210	11,243	10,967	53.54	52.23
240*	12,126	12,420	50.52	51.75*
270*	13,008	13,872	48.18	51.38*

*Acreage levels where the average total investment requirement for flooding systems exceeded that for sprinkling systems.

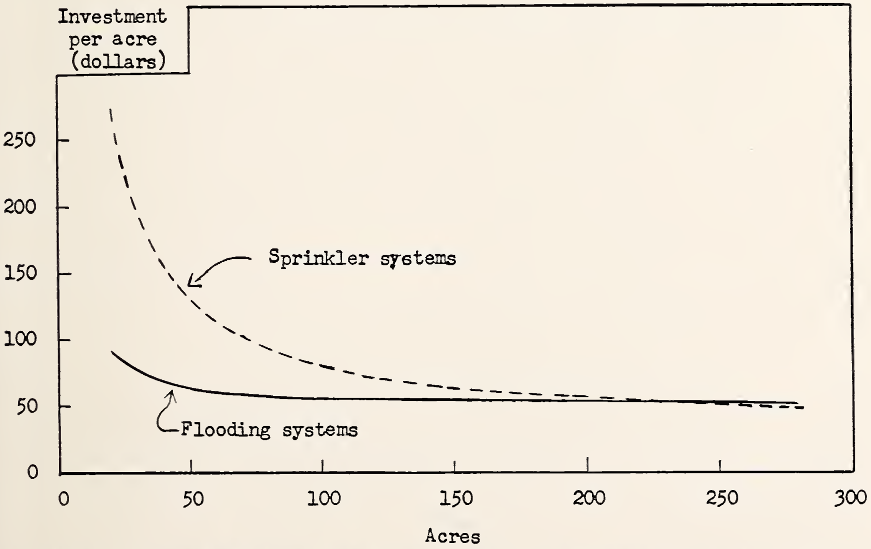


FIGURE 2.—Average Investment per Acre in Irrigation Systems Used on Cotton Farms, North Louisiana, 1956.

ing, any expansion requires more leveling. To expand from 30 to 40 acres of cotton irrigated by flooding on land requiring leveling would mean that all the additional land would have to be leveled and the investment requirement would be increased in proportion to the increase in size. (Investment in land preparation is shown later in Table 2.)

The data shown in Table 1 are also presented graphically in Figure 2. It can be seen that the average investment requirement per acre decreased for both types of systems as larger acreages were irrigated. The relative decrease in investment requirement per acre for sprinkler systems was greater than that for flooding systems as size of systems increased. The major portion of the decrease in investment per acre occurred below the 50-acre level for flooding systems, and beyond this point per acre investment remained rather constant. The investment per acre for sprinkling decreased to the 150-acre level before it became relatively constant for larger acreages.

It should be emphasized that these data were derived from a farm survey. They do not necessarily represent the investment requirements for ideal systems. This is especially true on smaller acreages using flooding systems. The equipment used on many of the smaller farms lacked uniformity and the irrigating practices used often did not conform to those recommended by irrigation specialists. Inadequate land leveling was commonplace.

One of the questions asked farmers in this study had to do with their estimate of the amount of land their irrigation system would cover if it were being used to capacity. Many farmers using flooding systems indicated that they were not using their systems to capacity, while some farmers using sprinkler systems thought they had extended the use of their system beyond its most economical capacity, especially the larger systems. Because of extremely dry conditions they tried to cover more acres than could adequately be done with sprinkler systems of the size owned.

Source of Water and Investment

The source of water affects the investment in both sprinkler and flooding systems. It determines whether or not a well must be dug or whether a pond, reservoir, or dam must be constructed. If water is pumped directly from a natural lake or stream none of these items will be necessary.

The use of a well almost always requires a duplication of pumps and motors when sprinkler systems are used. Even when surface water sources are used for sprinkling, requiring only one pump and motor, this must usually be a larger pump and more powerful motor than required for flooding systems, because the unit must also be able to force water through sprinklers under pressure. Very seldom is one pump and motor sufficient for pulling water out of a well and also for forcing it through the sprinkler system.

In addition to the increase in investment requirement for installation, adding a well to a flooding system may require a more powerful pumping unit than needed for surface water sources to raise water from a greater depth. However, one pump and motor will still serve this function. Hence, the increase in investment required for flooding systems when wells are used will usually not be so great as is the case when wells are added to sprinkler systems. Wells were used on 18 of the farms. Separate well cost data for 13 of these averaged $1,440, varying from as low as $400 to as high as $3,000, depending on kind, size, and depth.

Investment in Land Preparation

On farms irrigating cotton with flooding systems land preparation (including land leveling and construction of ditches for conducting irrigation water) usually represents a large part of the investment required. Not all farms using flooding incurred a land leveling charge, however, because some of them, especially in the smaller acreages, were not operating according to usual recommendations.[2]

The investment for land preparation on those farms using flooding systems, and on which land leveling represented a part of the total investment, is shown in Table 2. The relatively small investment shown for the smaller acreages may be explained by the fact that most of the farms in this size group did very little land leveling. The operator did most of that which was done with whatever equipment he had available. The major portion of the costs shown at the lower acreage levels was the cost of ditch construction rather than leveling. With each 30-acre increase in size the increase in the average total investment requirement for land preparation was about $516. The increase in total investment was not proportionate to the increase in size of acreage irrigated.

---

[2] Harry Rubey, *Supplemental Irrigation for Missouri and Regions of Similar Rainfall* (Third Revised Edition, Columbia, Missouri: The University of Missouri Engineering Experiment Station Bulletin No. 33, 1953), Vol. 54, P. 31.

TABLE 2.—Investment Requirement for Land Preparation on Farms Irrigating Cotton, North Louisiana, 1956[1]

Acres irrigated	Land Preparation	
	Flooding system	Sprinkling system
30	$ 373	$ 260
60	890	431
90	1,405	601
120	1,922	771
150	2,438	942
180	2,954	1,112
210	3,470	1,283
240	3,986	1,453
270	4,502	1,623

[1] Includes investment requirement for both land leveling and ditch construction for flooding systems and for ditch construction only for sprinkler systems.

It should be emphasized that the investment data shown for land preparation for flooding systems in Table 2 do not necessarily represent the expenditure for a complete leveling job. Wide variation in leveling cost for the same number of acres irrigated (on similar land) indicated varying degrees of application of recommended leveling practices.[3] Since irrigation is a relatively new practice, many farmers irrigating only a few acres with flooding systems on relatively flat land do so on an experimental and often somewhat make-shift basis. The uneveness of water application by flooding, without adequate leveling, apparently does not concern the operator so much as the fact that by this method of application he is able to increase yields with a relatively low initial investment.

Had all the land irrigated by flooding systems, especially on the smaller acreages, been leveled according to the usual recommendations, the average total investment requirement (Table 2) for land preparation would have been higher and the over-all difference in investment (between flooding and sprinkling, Table 1) much smaller. However, much of the land presently being irrigated by flooding systems is relatively flat, and extensive leveling would not have been required on many of the smaller farms.

Because of the relatively slow rate of water application when sprinkler systems are used there is less runoff and land leveling is not necessary. Usually the water applied by sprinkler systems is conducted from the source to the place of use through pipe. In some instances open ditches were used for this purpose. The investment requirement for land preparation on farms using sprinkler systems (Table 2) represents ditch construction. For each 30-acre increase in size of sprinkler system this was about $171.

---

[3] Harry Rubey, *Ibid,* p. 31. All of the leveling on the farms in this study was for irrigation purposes. Leveling is sometimes done for other purposes, such as drainage. Where it is done for both purposes all of the investment should probably not be a cost to irrigation. Land leveling for better drainage can also contribute to yields, especially in wet years. It is a recommended practice in some areas.

Investment in Equipment

Usually the major portion of the investment in an irrigation system was made up of the investment in various kinds of equipment. Particularly was this true for sprinkler systems since they usually required a higher investment than flooding systems in such items as pipe, pumps, and motors.

In most cases it was not possible to obtain the actual expenditure for each item separately because some of the systems were installed as "package" units (including a well in some cases) and were paid for in one bill. In such cases farmers knew only their total equipment investment.

All of the individual items of equipment commonly used for irrigation were not necessarily used on any one system, either sprinkling or flooding. Also, some of the items used are not shown separately here because of the limited amount of data for the individual items. Therefore, a total investment figure for equipment, obtained by summing the investment figures for the individual items shown following, *can not* be used to represent the total investment in this equipment required on any one size of farm.[4] Rather, the data following represent an average for each item on the farms which used it. Enough data were obtained on these items to allow estimates that are considered reasonably accurate.

Pipe

Pipe is a major item of equipment in sprinkler systems. In most cases pipe is also used to conduct water from the origin to the sprinkler system proper. Flooding systems also use pipe for the same purpose except that the water is usually emptied into a ditch in or near the field that is to be irrigated.

Usually a larger quantity of pipe is necessary for sprinkler systems than for flooding systems. In this study the number of feet of pipe used on each system was obtained when possible. The total and per acre average length of pipe used on each type of system for the various acreages is shown in Table 3. The wide difference in the amount of pipe required for the two types of systems is readily apparent. As the number of acres irrigated increases, the length of pipe per acre decreases considerably. For sprinkler systems most of this decrease occurs below the 90-acre level and for flooding systems, below the 60-acre level. Sprinkler systems have a great capacity for being used over more acres without requiring a proportionate increase in the size of the system.

---

[4] For the same reason the estimates of total investment obtained directly (Table 1) are more accurate than a total obtained by summing estimates for individual items.

TABLE 3.—Average Total Length of Pipe and Length per Acre on Farms Irrigating Cotton, North Louisiana, 1956

Number of acres irrigated	Feet of pipe			
	Total		Average per acre	
	Sprinkler	Flooding	Sprinkler	Flooding
30	1,944	513	64.8	17.1
60	2,501	676	41.7	11.3
90	3,058	839	34.0	9.3
120	3,615	1,001	30.1	8.3
150	4,172	1,164	27.8	7.8
180	4,729	1,326	26.3	7.4
210	5,286	1,489	25.2	7.1
240	5,843	1,652	24.4	6.9
270	6,400	1,814	23.7	6.7

The total and per acre investment in pipe on each of the two systems, computed from the dollar figures as reported by the farm-

TABLE 4.—Average Total Investment in Pipe and Investment per Acre for Irrigation Systems used on Cotton, North Louisiana Farms, 1956

Number of acres irrigated	Investment in pipe			
	Total		Per acre	
	Sprinkler	Flooding	Sprinkler	Flooding
30	$ 2,487	$ 898	$82.91	$29.93
60	3,495	1,073	58.25	17.88
90	4,503	1,249	50.03	13.88
120	5,511	1,424	45.92	11.87
150	6,519	1,600	43.46	10.67
180	7,526	1,775	41.81	9.86
210	8,534	1,950	40.64	9.29
240	9,541	2,126	39.76	8.86
270	10,550	2,301	39.07	8.52

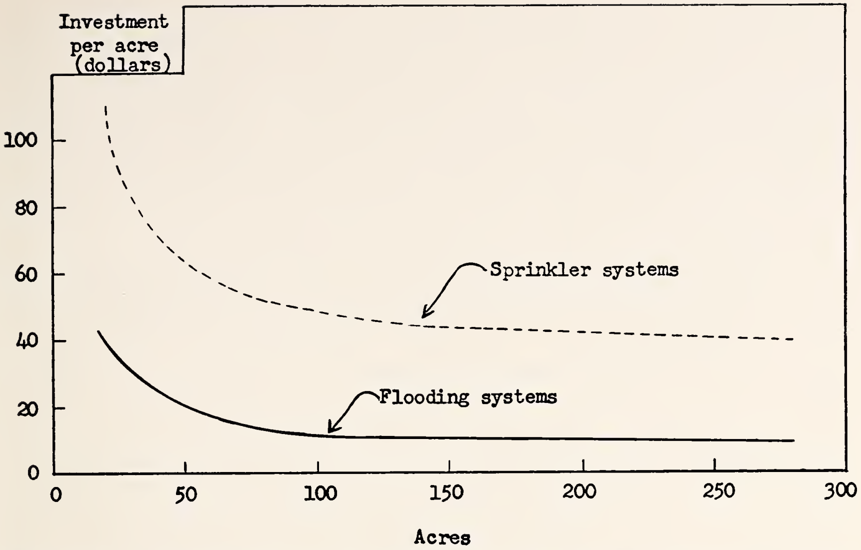


FIGURE 3.—Investment per Acre in Pipe on Farms Irrigating Cotton, North Louisiana, 1956.

ers, is shown in Table 4. The investment in pipe per acre is also shown in Figure 3. The averages shown in Table 4 do not have exactly the same relationship as those for the physical data (feet of pipe per acre) in Table 3. This is due to the variation in sizes of pipe making up the systems and hence the variation in investment as a result of different prices paid for different sizes.

TABLE 5.—Investment in Siphons, Sprinklers, Culverts, and "Other" Equipment on Farms Irrigating Cotton, North Louisiana, 1956

Number of acres irrigated	Total investment			
	Siphons	Sprinklers	Culverts	"Other" Equipment
30	$ 101	$ 169	$ 100	$ 166
60	115	239	107	246
90	128	309	114	326
120	142	380	121	406
150	155	450	128	485
180	169	520	135	565
210	182	590	142	645
240	196	660	149	725
270	209	730	155	805

Siphons

Siphons are used with flooding systems to conduct water over the embankment of the irrigation ditch and into the furrow. Some farmers applied water directly by cutting the ditch levees and letting the water flow onto the field. On farms using siphons the investment for various acreages is shown in Table 5.

Sprinklers

Sprinklers are a necessary item of equipment on all farms irrigating with sprinkler systems. Although it was not possible to obtain the actual amount invested in this item on all farms, the investment figures based on the data that were obtained are presented in Table 5.

Culverts

Culverts are used by both types of systems on some farms, primarily for transferring water under roads. The average investment in culverts (where used) is presented in Table 5.

"Other" Equipment

For both flooding and sprinkling systems some investment was often required for special need for a particular system. However, the number of systems having such items of "other equipment" was sufficient to be treated separately.[5] The investment requirement for these items on the farms where they made up a portion of the total investment is shown in Table 5.

III. COSTS OF IRRIGATION

The cost of irrigation is made up of fixed costs and operating costs. Fixed cost is the charge made against the investment each year. Operating (or variable) costs include such variable items as labor and fuel used directly in the irrigation process and "additional costs" which *result from* irrigation. Additional costs are primarily labor costs that arise because of irrigation but not necessarily at the time of irrigation. The cost of picking the additional yield due to irrigation would be an example. These costs are sometimes overlooked in computing the cost of irrigation. Actually they warrant special consideration because they may easily be more than 50 percent of the cost associated with irrigation. In this study, for example, "additional" costs averaged about 63 percent of the total costs (Table 12).

---

[5] This classification includes such items of equipment as well curbing where pumps are installed below the surface of the ground and dams or water gates that are constructed in ditches, etc.

While individual cost items differed somewhat between flooding and sprinkling systems (for example, the cost of investment in leveling vs. pipe and sprinklers), they also tended to cancel, leaving no substantial difference in total costs. In addition, the costs for the 71 farms as a whole are considered better estimates than those for the individual systems. Thus, most of the following data is an average of the costs for the two systems.[6]

Fixed Cost

The annual "fixed cost" of an irrigation system is made up of the charges for depreciation and interest on the total investment for a particular year. Total annual fixed cost is a constant. That is, it remains the same whether the system is used once, none, or five times during the year. Fixed cost per acre decreases, however, as the total cost is spread over more acres. The amount the system is used during the year determines the *proportion* fixed cost is of the total cost for the year (since total variable costs increase the more the system is used while total fixed cost does not). For most farms in this study the fixed cost made up a relatively small proportion of the total cost of irrigating in 1956.

Since some of the systems were used to irrigate other crops in addition to cotton not all of the fixed cost for the 1956 growing season was chargeable to cotton. In these instances only the proportion that the irrigation system was used on cotton was charged as a cost of cotton irrigation. Generally, this was the major portion of the fixed cost of owning the system.

Depreciation

An annual depreciation charge of 6.7 percent of the total investment was used, based on an average estimated life of 15 years for the whole system.[7] At the end of 15 years the system will, theoretically, have depreciated to the point where it has no value.

---

[6] Sample farms were originally selected randomly from a population stratified by acreage. However, changes made by farmers in acres irrigated after the sample was selected and a lack of farms in the higher acreage range made substitutions necessary and prevent qualification as a strict random stratified sample. Nevertheless, tests of significance of observed difference were used for differences in "a," "b" and selected regression Y values in the various regression equations. The "a" and "b" values were often significant but differences in regression Y were not. (See also footnote 10.)

Total annual and average cost per acre for depreciation charged to cotton irrigation, for both sprinkler and flooding systems, is shown in Table 6. Depreciation costs per acre decreased with increases in the acreage irrigated.

Interest

The 6 percent interest charge on capital invested in the irrigation system is considered to be the cost of having money invested in irrigation rather than in some other way. The money could have been invested in an alternative use which would have yielded a return at least equal to the interest charge.

TABLE 6.—Total and Average Annual Depreciation and Interest Cost for Irrigating Cotton, North Louisiana Farms, 1956

Acres of cotton irrigated	Depreciation cost		Interest charge	
	Total	Per acre	Total	Per acre
30	$ 274	$ 9.13	$ 122	$ 4.07
60	352	5.87	158	2.63
90	430	4.78	195	2.17
120	509	4.24	203	1.69
150	587	3.91	271	1.81
180	665	3.69	298	1.66
210	743	3.54	308	1.47
240	822	3.43	368	1.53
270	900	3.33	404	1.50

Because of the "use" depreciation as the equipment is used it is not accurate to charge interest on the total amount of the investment each year. Since over the lifetime of the system the investment will be depreciated or used up, interest is charged on one-half the original investment. Interest is also a fixed annual charge against investment that decreases, on a per acre basis, as it is spread over more acres. Table 6 shows the interest charge on the total investment.

---

[7] Most of the farmers had no idea how long some items of equipment would last. In several cases items such as pipe and motors had been used for several years for other purposes and were of undetermined value. Because of lack of information and dis-uniformity of items within each classification of equipment it was impossible to compute a depreciation schedule for each separate equipment classification. Therefore, an average estimate of life of 15 years was used for the whole system and an annual depreciation charge was computed accordingly. Similar charges have been used in other studies. See, for example: Oregon Agricultural Experiment Station Bulletin 532, March, 1953; Idaho Experiment Station Bulletin No. 287, December, 1952; and New Mexico Agricultural Experiment Station Bulletin 383, December, 1953.

Operating Costs

The operating costs of irrigation include such direct costs as labor, power, repairs, and lubrication during irrigation and those costs incurred as a *result of* using the irrigation system (primarily the labor costs of "additional" chopping, cultivating, poisoning and picking).[8] The latter items are often overlooked in considering costs of irrigation.

Labor Hours

Labor is a major item of operating cost in irrigation. It is necessary for operating the irrigation system and also for the additional operations which result from irrigating. Table 7 shows the average total hours of labor required for *one* irrigation plus the hours of labor used in the *additional operations.* The labor used in the additional operations exceeded considerably the labor used for the irrigation operation alone.

Labor for irrigation alone *decreased* (per acre) as the number of acres irrigated increased. Most of the decrease occurred below the 100-acre level. The labor per acre per irrigation for the "additional" operation *increased* as more acres were irrigated. Most of this increase occurred below the 100-acre level. Beyond this acreage the additional labor requirements tended to remain constant.

The increase in per acre labor requirements for additional operations as acres increase can be explained by the fact that operators on larger farms usually were not limited by the amount of capital available and were usually better informed as to recommended production practices. As a result they followed schedules more exactly in insect control (poisoned more often) and spent more time in cultivating and chopping, thereby maintaining better control over vegetation in the crop. The combined effect of these operations was to

---

[8] It would normally be expected that fertilizer would make up a substantial part of the "additional costs." However, in this study only about 10 percent of the farmers said they had used extra fertilizer on account of irrigation. The reason the remainder did not use extra fertilizer was not determined. It is most likely that the majority of farmers are not acquainted with the relationship between water, fertilizer, and yields. There is, at present, very little experimental data to establish these relationships. The use of additional fertilizer would add to both costs and returns. Accurate determination of the economic levels of water-fertilizer combinations will have to wait for more experimental information.

TABLE 7.—Hours of Labor for One Irrigation and the Associated "Additional" Operations, North Louisiana Cotton Farms, 1956

Acres of cotton irrigated	Total hours of labor per irrigation			Hours of labor per acre for one irrigation	
	Irrigation alone[1]	Additional operations[2]	Total	Irrigation alone[1]	Additional operations[2]
30	99.9	453.3	553.0	3.33	15.11
60	165.0	1051.5	1216.5	2.75	17.53
90	230.0	1649.8	1879.7	2.56	18.33
120	295.1	2248.0	2543.1	2.46	18.74
150	360.1	2846.3	3206.4	2.40	18.98
180	425.2	3444.5	3869.7	2.37	19.14
210	490.3	4042.7	4533.0	2.34	19.25
240	555.3	4641.0	5196.3	2.32	19.34
270	620.4	5239.1	5859.6	2.30	19.41

[1] The hours of labor expended in the irrigation operation.

[2] The hours of labor expended in additional operations that were performed as a result of irrigating, such as extra chopping, poisoning, cultivating, and picking the additional yield.

increase the yield per acre; thus additional hours of labor were required for harvesting.[9]

Labor Cost

The labor cost for irrigation was obtained by applying a charge of 50 cents per hour to the hours of labor shown in Table 7 for each of the various sizes of irrigation systems. The data presented in Table 8 show the cost of the labor expended for irrigation.

TABLE 8.—Cost of Direct and "Additional" Labor for One Irrigation of Cotton, North Louisiana Farms, 1956

Acres of cotton irrigated	Direct labor cost[1]		Additional cost[2]	
	Per irrigation	Per acre per irrigation	Per irrigation	Per acre per irrigation
30	$ 49.93	$ 1.66	$ 243	$ 8.10
60	82.47	1.37	646	10.77
90	114.98	1.28	1,049	11.66
120	147.52	1.23	1,452	12.10
150	180.06	1.20	1,855	12.37
180	212.60	1.18	2,258	12.54
210	245.17	1.17	2,662	12.68
240	277.66	1.16	3,065	12.77
270	305.70	1.13	3,468	12.84

[1] The cost of labor expended directly in the irrigation operation.

[2] Includes the cost of additional cultivations, chopping, poisoning, and picking that was necessary as a result of irrigation.

---

[9] This is shown later in this analysis by the additional yields per acre from irrigation (Table 13).

All of the costs associated with the operation of an irrigation system cannot be accounted for in the direct costs of irrigation. As a result of irrigating cotton it is often necessary to poison more for insect control, to cultivate an extra time and to chop an extra time to control extra vegetation brought on by irrigation. Finally, there is the added expense of harvesting the extra yield that irrigation is responsible for. The cost of all the "additional" operations performed is an important and often neglected part of the cost of irrigation. These costs, as shown in Table 8, may often be much greater than the cost of labor used directly in the process of irrigation. Since a major portion of "additional" cost is harvesting cost (about 66 percent in this study) this item will vary with yields.

The cost *per acre* per irrigation of the additional operations increased as more acres were irrigated (due primarily to higher yields on larger farms) while the labor cost of the irrigation operation itself decreased.

Power, Lubrication, and Repair Costs

Power is another variable cost of irrigation. The main sources of power used by farmers in this study were butane and electricity. Other sources of power were also used, such as gasoline, tractor fuel, and diesel fuel.

The power cost for one irrigation (an average of both sprinkler and flooding systems) is shown in Table 9. The data indicated that power cost for sprinkling systems was higher than for flooding systems. Since many sprinkler systems require two motors to irrigate a given acreage while flooding systems usually require only one motor to irrigate an acreage of the same size, this difference in power cost is to be expected.

Lubrication is a minor item in the expense of operating an irrigation system. On many systems using electric motors the expense for lubrication was negligible. Systems powered by internal combustion motors use varying amounts of oil. Table 9 presents an average of the costs for lubrication on both sprinkler and flooding type irrigation systems. The lubrication cost per acre for both systems decreased with increases in acreage irrigated.

Another relatively small expense of irrigation is the cost of repairs. This usually includes such things as minor repair work to pumps, motors, and pipes. Because of the relative newness of some of the systems in use, some farmers did not have a repair cost for the 1956 growing season. Table 9 shows the average repair cost per irri-

TABLE 9.—Power, Lubrication, and Repair Costs for One Irrigation on Farms Irrigating Cotton, North Louisiana, 1956

	Power cost	Lubrication cost	Repair cost
Acres of cotton irrigated	Per acre per irrigation	Per acre per irrigation	Per acre per irrigation
30	$ 1.37	$ .09	$ .31
60	1.27	.07	.27
90	1.24	.06	.26
120	1.23	.05	.25
150	1.21	.05	.25
180	1.21	.05	.25
210	1.20	.05	.25
240	1.20	.05	.24
270	1.20	.05	.24

gation. Repair cost per acre decreased as acreage irrigated increased.

IV. ESTIMATING "EXPECTED COSTS" OF IRRIGATION

If a farmer irrigates his crop only one time the total cost per irrigation would be the total amount of the operating cost plus the total amount of the fixed cost. However, the total cost of two irrigations is not determined by multiplying the cost of one irrigation by two. Although this would correctly show the operating cost of two irrigations, fixed cost would be overstated because this would indicate that fixed cost had doubled as a result of irrigating another time. This cannot be true, because the annual fixed cost is a constant charge not affected by the number of irrigations. For example, interest on the investment does not double for two irrigations or triple for three. Labor and fuel cost, on the other hand, may nearly double for two irrigations or nearly triple for three. Annual fixed cost is not a function of the number of irrigations. But operating costs are.

The correct method of computing the cost of two irrigations (for a given acreage), or of any other number of irrigations, is one which multiplies the operating cost for one irrigation by the number of irrigations and then adds to that product the constant amount of the fixed cost. This method of computation is used in Table 10 in showing the estimated cost per acre of irrigating cotton one, two, and three times.

TABLE 10.—"Bench Mark" Estimates for the Cost of Irrigation[1]

Acres of cotton irrigated	Operating cost per acre per irrigation	Fixed cost	Average cost per acre and number of irrigations		
			One	Two	Three
30	$12.89	$13.20	$26.09	$38.98	$51.87
60	14.54	8.50	23.04	37.58	52.12
90	15.10	6.95	22.05	37.15	52.25
120	15.37	5.93	21.30	36.67	52.04
150	15.53	5.72	21.25	36.78	52.31
180	15.64	5.35	20.99	36.63	52.27
210	15.72	5.01	20.73	36.45	52.17
240	15.78	4.96	20.74	36.52	52.30
270	15.82	4.83	20.65	36.47	52.29

[1] The operating costs shown include "additional" costs and were derived from the 1956 data. Thus, these costs assume an increase in yields of cotton as acreage increases.

The total cost per acre for one irrigation (at a given acreage) is determined by adding the constant amount of the fixed cost per acre to the operating cost per acre for one irrigation. The operating cost is doubled and the constant fixed cost is added to it in computing the total cost per acre for two irrigations. The process can be continued for more irrigations.

V. COST OF IRRIGATING COTTON—1956

The previous section, "Estimating Expected Costs of Irrigation," presented estimates based on the individual items of cost to show how expected costs of irrigation should be computed and to provide "*bench mark*" estimates for planning purposes. The data shown in Part IV were based on estimates from Part III on "Costs of Irrigation" and were *adjusted to take into account the number of irrigations on each farm.*

In this section, however, we are simply concerned with the cost of irrigation in 1956, without regard to the number of irrigations. The data shown in Table 11 are averages of the actual cost of irrigation on the 71 farms in the survey. Later, these costs will be subtracted from income to obtain the *net* returns from irrigation on the farms in 1956.

Cost per acre in 1956 averaged around $40 to $41 per acre regardless of the number of acres irrigated. These costs include extra poisoning, the charge for picking the extra cotton, and similar "additional" costs. The relationship between total cost and acres irrigated is also shown in Figure 4. Points on the two regression lines

TABLE 11.—Average Total Cost of Irrigating Cotton, 71 North Louisiana Farms, 1956

Acres of cotton irrigated	Total cost	Cost per acre
30	$ 1,207	$40.23
60	2,444	40.73
90	3,683	40.92
120	4,920	41.00
150	6,158	41.05
180	7,396	41.09
210	8,634	41.11
240	9,872	41.13
270	11,110	41.15

represent an average of total cost for the particular system and a given acreage. Statistical tests indicated the observed difference in average costs between systems could be due to chance. Thus the data were combined as shown in the table.[10]

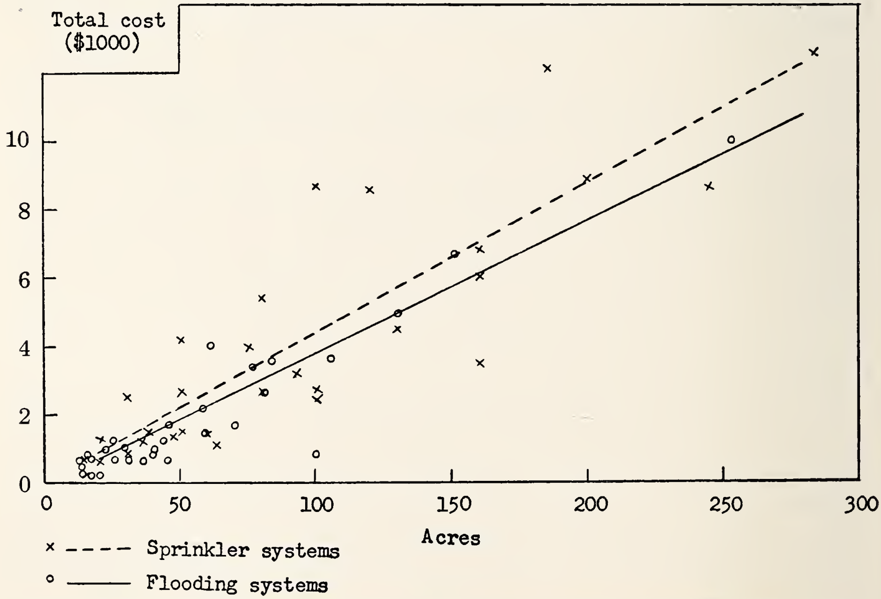


FIGURE 4.—Total Cost of Irrigating Cotton, North Louisiana Farms, 1956.

---

[10] The "a," "b" and selected values of regression Y were tested for significance of difference. Values of "b" (slope) were significantly different at the 5 per cent level of probability. Differences in "a" and selected regression Y were not significant.

About 23 of the farmers irrigated once, 24 irrigated twice, 8 irrigated three times, 11 irrigated four times, etc. The average number of irrigations for the 71 farms was 2.36. If this figure (2.36) is used with the data in Table 10 it will show that costs per acre for 2.36 irrigations is about $41-$43 per acre.

The proportionate distribution of costs on the 71 farms for 1956 is shown in Table 12. The relative importance of the "additional" operations is evident. With lower additional yields resulting from irrigation the percentage cost for additional operations (particularly harvesting) would be lower. Ignoring "additional" costs, the costs for the irrigation operation alone in 1956 were on the average, about evenly split between variable and fixed costs. In a drier year, requiring more irrigations, the variable costs would be more important.

TABLE 12.—Proportional Distribution of Irrigation Costs

Cost item	Average
	Percent
Fixed:	
Depreciation	12.5
Interest	5.5
Operating:	
Repairs	2.0
Labor[1]	9.5
Power	7.0
Lubrication	—
"Additional"[2]	63.0
	100.00

[1] Directly connected with irrigation.

[2] "Additional" operations (chopping, picking, poisoning, etc.). Of the additional operations about 66 percent was for picking, about 24 percent for extra poisoning, and about 10 percent for extra chopping.

VI. THE RETURNS TO IRRIGATION—1956

Most of the farms included in this study had both irrigated and non-irrigated cotton. This made it possible to obtain a comparison between the yields of irrigated and non-irrigated cotton grown on the same farm under the same general conditions except for the additional water applied to the irrigated cotton and the additional operations that were performed as a result of the application of water. The yields shown are the amounts irrigated cotton exceeded non-irrigated cotton. The cost differences were accounted for in the "additional" cost of producing irrigated cotton.

Yield Increase

The average increase in total yield of seed cotton due to irrigation on the 71 farms is shown in Table 13 and Figure 5. These data show the combined yield increases of both sprinkler and flooding irrigation systems since the difference between the two was not large enough to warrant separate presentation. From these data it can be seen that with each 30-acre increase in the number of acres irrigated the total increase in yield of seed cotton was about 26,160 pounds.

TABLE 13.—Increase in Yield of Seed Cotton Due to Irrigation, North Louisiana Farms, 1956

Acres of cotton irrigated	Yield increase of seed cotton	
	Total pounds	Pounds per acre
30	18,646	622
60	44,806	747
90	70,966	789
120	97,127	809
150	123,287	822
180	149,448	830
210	175,608	836
240	201,769	841
270	227,929	844

As the number of acres irrigated increased there was an increase in yield of seed cotton per acre (Table 13 and Figure 6).

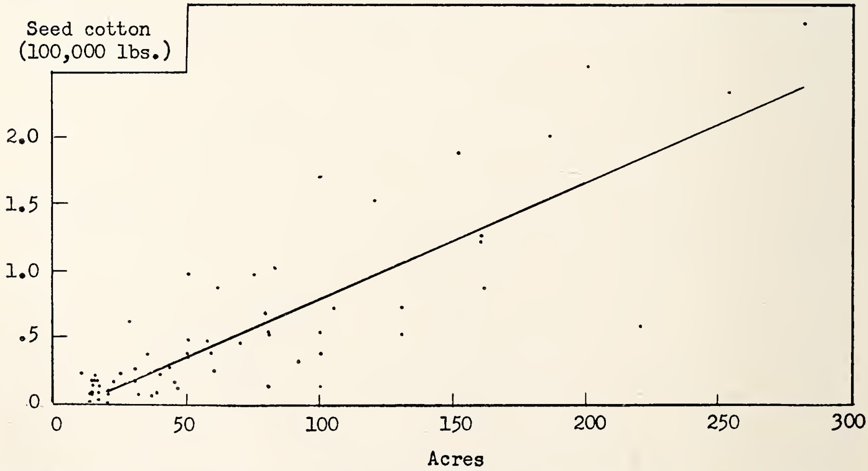


FIGURE 5.—Yield Increase in Pounds of Seed Cotton Due to Irrigation, North Louisiana Farms, 1956.

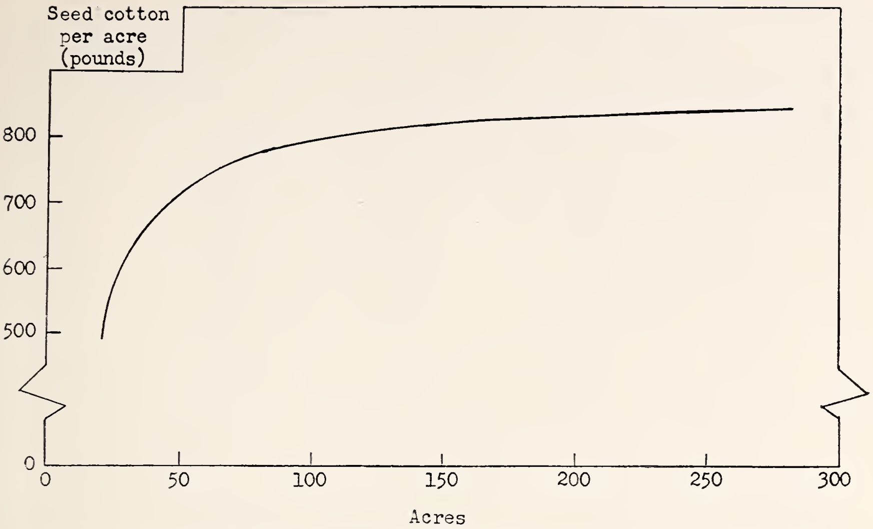


FIGURE 6.—Yield Increase in Pounds of Seed Cotton per Acre Due to Irrigation, North Louisiana Farms, 1956.

Most of the increase occurred below the 100-acre level. Beyond this point the yield per acre tended to level off and remain constant at about 835 pounds per acre regardless of increases in size. The greater increase in yield per acre on larger farms reflects the combined effects of several factors such as more effective irrigation, better control of insects, and better cultural practices.

Gross Added Returns

The total returns obtained from irrigating cotton is the value of the additional yield that results from irrigation. The 1956 season average price farmers received for cotton was applied to the physical data to obtain the total added return from irrigation shown in Table 14. With each 30-acre increase in the number of acres irrigated the average increase in total added revenue from irrigation was about $3,602. Table 14 and Figure 7 show the average increase in gross revenue per acre.

Net Added Returns

Whether or not irrigation is profitable on a farm depends on the *net* added returns (or net loss) from its use. Net returns is the residual of total (gross) returns after total costs have been subtracted. No matter how much total yields, and hence, total revenue, are increased from the use of irrigation, it will not be a profitable operation unless *net* revenue has also been increased.

TABLE 14.—Total Added Revenue and Cost and Net Revenue from Irrigating Cotton, 71 North Louisiana Farms, 1956

Acres of cotton irrigated	Total added revenue	Total added cost	Net added revenue	
			Total	Per acre
30	$ 2,576	$ 1,207	$ 1,369	$45.63
60	6,178	2,444	3,734	62.23
90	9,779	3,683	6,096	67.73
120	13,380	4,920	8,460	70.50
150	16,982	6,158	10,824	72.16
180	20,583	7,396	13,187	73.26
210	24,184	8 634	15,550	74.05
240	27,785	9,872	17,913	74.64
270	31,387	11,110	20,277	75.10

The average *net* added revenue due to irrigation on the 71 farms in this study for the 1956 season is shown in Table 14. These net added return figures were obtained by subtracting the total cost of irrigating from the total added revenue from irrigation, also shown in Table 14. Figure 8 also shows the net added revenue per acre as a result of irrigating cotton with sprinkler and flooding systems. The net added revenue per acre increased with an increase in the number of acres irrigated up to about the 100-acre level for both systems. Beyond this point the net added revenue tended to

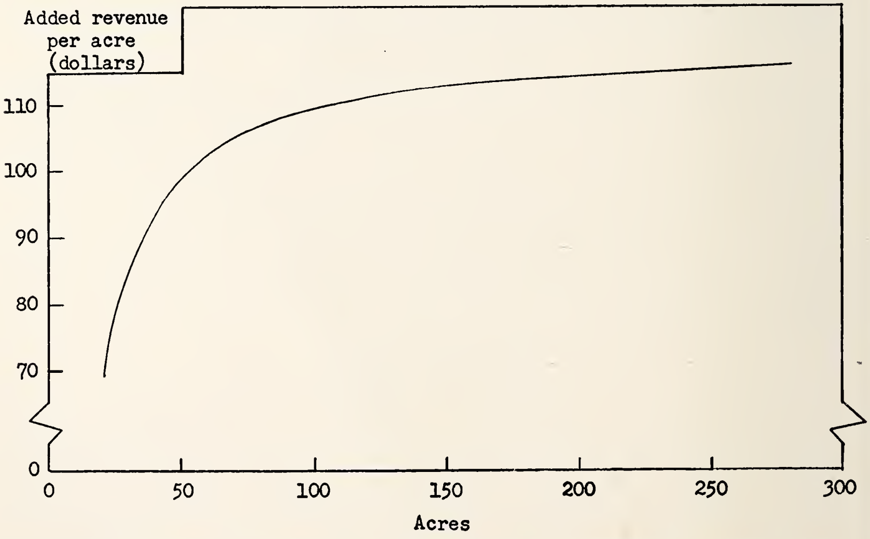


FIGURE 7.—Added Revenue per Acre Due to Irrigating Cotton, North Louisiana Farms, 1956.

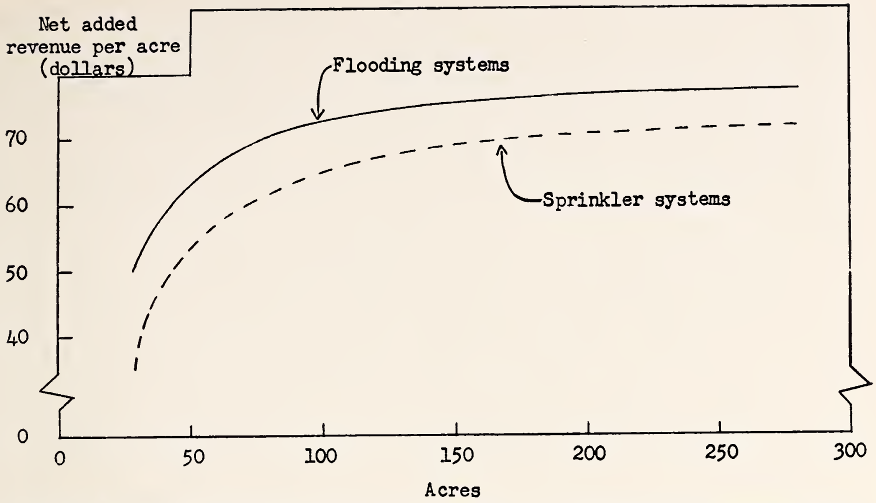


FIGURE 8.—Net Added Revenue per Acre as a Result of Irrigating Cotton, North Louisiana Farms, 1956.

level off at about $73 per acre. The reasons for the increase in net added revenue per acre, as the number of acres increased, are the same as those just given for the increase in total added yields.

VII. SUMMARY AND CONCLUSIONS

Summary

Interest in cotton irrigation in Louisiana has been increasing. Farmers are beginning to realize that irrigation offers opportunities for increasing profits on many farms over a period of years because the distribution of rainfall, even in humid areas, is often not optimum for crop production. Some farmers have installed irrigation systems of one of two general types, sprinkler or flooding systems. Other farmers are trying to decide whether or not an irrigation system would be profitable and which type of system would be best for their particular farms. The investment required and alternative uses for capital make this an important decision.

Some knowledge of the costs of irrigation and the returns that may be expected from its use is necessary if the decision is to be wisely made. The primary objective of this study was to provide this kind of information for cotton irrigation. Very little information of this nature is available in Louisiana at the present time.

The primary data used in the study were collected by personal interview with 39 farmers irrigating cotton with flooding systems and 32 farmers irrigating cotton with sprinkler systems in the Mississippi and Red River Delta Areas of North Louisiana. Most of the farmers also grew cotton which they did not irrigate. The yields of irrigated and non-irrigated cotton were compared in order to obtain the added yield resulting from irrigating.

Where it was feasible to do so, a comparison of sprinkler and flooding systems was made. It was shown that with each 30-acre increase in size the increase in the average total investment required for sprinkler systems was about $882 while that for flooding systems was about $1,452. The average level of investment in sprinkler systems, however, generally exceeded that of flooding systems, ranging downward from $198 per acre at 30 acres to $48 per acre at 270 acres for sprinkler systems, and from $75 to $51 per acre for flooding systems. Farmers' estimates of the "potential" acreage capacity of flooding systems generally exceeded the actual acreages over which they were being used. However, farmers using sprinkler systems indicated that they had already extended the use of these systems beyond their estimated potential acreage capacity.

Land leveling was a major item of investment for flooding systems, while no land leveling was required for sprinkler systems. The total investment for land preparation for flooding systems ranged from $373 at 30 acres to $5,018 at 300 acres, while the range was from $260 to $1,794 for sprinkler systems for the same range in acreage.

The investment in equipment made up the major portion of the average investment requirement in irrigation systems on the farms included in the study. Items of equipment on which data were obtained included wells, motors, pumps, pipe, siphons, sprinklers, culverts, and "other" equipment. Sprinkler systems, of course, required much more pipe than did flooding systems. The average investment in pipe for sprinkler systems ranged downward from $82.91 per acre at 30 acres to $39.07 at 270 acres. For the same size range the average investment in pipe for flooding systems ranged from $29.93 to $8.52 per acre. The investment in the remaining items of equipment made up relatively small portions of the total investment in equipment. Investment per acre in all these items decreased as acres irrigated increased.

The total cost of irrigation includes the two general categories, fixed and variable costs. Fixed cost includes charges for depreciation and interest on the total investment. Depreciation was computed at 6.7 percent of the total investment and averaged from $9.13

per acre at 30 acres to $3.33 per acre at 270 acres. Interest was computed at 6 percent of one-half of the total investment and ranged from $4.07 per acre at 30 acres to $1.50 per acre at 270 acres.

The operating or variable cost of irrigation included labor, power, lubrication, and repairs expended directly in the irrigation operation plus the expenses of the "additional" operations performed as a result of irrigation.

Labor was one of the major items of cost in the operation of both sprinkler and flooding systems. Most of the labor cost was for indirect items, such as chopping, picking the additional cotton, and extra cultivations and poisoning, rather than for the irrigation operation itself. The cost per acre of labor for "additional" operations increased from about $8.10 per irrigation at 30 acres to $12.84 per irrigation at 270 acres. The cost per irrigation of labor expended directly in the irrigation operation decreased from $1.66 to $1.13 per acre per irrigation over the same range. The costs of power, lubrication, and repairs per irrigation were of minor importance as compared to the other costs.

The average total cost of irrigation on the 71 farms in 1956 ranged upward from $1,207 at 30 acres to $11,110 at 270 acres. Average cost per acre was about $41 over the range in acreage in 1956. Since the range in costs was wide and overlapped between systems (flooding and sprinkling) differences observed were considered due to chance, and the data were combined.

There was no appreciable difference in the additional yield of seed cotton obtained from irrigating with the two systems. The average additional yield resulting from irrigation for each 30-acre increase in acres irrigated was about 26,160 pounds. Added yields increased from 622 pounds of seed cotton at 30 acres to 844 pounds at 270 acres. The added gross revenue per acre resulting from irrigation was related to increases in acreage in the same manner as added yield per acre. The average *net* added revenue per acre from irrigation increased from $45 at 30 acres to $75 at 270 acres.

Conclusions

On the 71 farms included in this study the operation of an irrigation system for cotton in 1956 was highly profitable. The profit per acre was somewhat greater when larger acreages were irrigated than when smaller acreages were irrigated. Though the fixed cost per acre decreased as acreage irrigated increased, operating costs per acre increased so that the effects of these two components of total cost tended to be offsetting. Thus, total cost per acre tended to remain relatively constant throughout the range in acreage for both systems. Gross returns from irrigation more than paid for the use of the systems in 1956, a year that was relatively dry.

The results of this study should be of use to farmers who are considering irrigating cotton. The costs and returns presented here may not be those that could be expected from systems operated under ideal conditions or every year. They do represent results of cotton irrigation based on experience in the Delta Areas in 1956. As such they provide an indication of what may be expected from the irrigation of cotton in the future, where weather and related conditions approximate those existing during 1956.

Whether to install an irrigation system, the kind to use, and related decisions are problems that must be decided for the individual farm.

38.1
93L
L
513

Soil Phosphorus and Its Fractions As Related to Response of Sugar Cane to Fertilizer Phosphorus

D. S. BYRNSIDE, JR. AND M. B. STURGIS

Complete fertilizer on left, no fertilizer on right

BULLETIN No. 513 MARCH 1958

LOUISIANA STATE UNIVERSITY AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
CHARLES W. UPP, Director

CONTENTS

Page

Experimental 5

- Soils and Soil Material 5
- Evaluation of Various Methods 6
- Development and Evaluation of New Method 7
- Method Proposed 12
- Chemical Procedure 12

Results and Discussion 16

Summary 27

Literature Cited 28

Soil Phosphorus and Its Fractions as Related to Response of Sugar Cane to Fertilizer Phosphorus

D. S. Byrnside, Jr., and M. B. Sturgis[1]

Abstract

Although chemical procedures for determining "available" phosphorus in soils were first proposed approximately a century ago, efforts to interpret soil phosphorus values in terms of plant responses to fertilizers are still in some cases a difficult undertaking. Because of the key position of phosphorus as a plant nutrient element and the generally low level of "available" or easily-soluble phosphorus in most soils, the determination of phosphorus continues to be one of the most frequent determinations made in soil analysis.

Relatively little information is available in Louisiana on the relationships of soil phosphorus and its fractions to the response of sugar cane to fertilizer phosphorus. Attempts to correlate acid-soluble phosphorus with response have met with difficulty. In the older soils the dilute acids used failed to extract proportionately as much soil phosphorus as the crop roots absorbed. The purposes of this study have been to measure the values of "adsorbed," organic and total phosphorus in the soils of the sugar cane area of Louisiana. Dilute acid-soluble phosphorus has been determined by various methods and the results evaluated in relation to the growth of sugar cane. A final purpose has been to select or develop a chemical method for the determination of easily-soluble or "available" phosphorus which would better characterize the amount of soil phosphorus which could be used by the crop or that could be correlated with yield.

In the past, a number of investigators (10,26)[2] have advocated the use of weak acids, such as citric or acetic, as extracting solutions for the determination of "available" or easily-soluble phosphorus in soils. Other workers (2,16,17,18,29,34) have used solutions of highly ionized acids, such as hydrochloric, nitric and sulfuric, as solvents for assessing the phosphorus needs of soils. Similarly, still other investigators (4,5,6,7,8,33,36,40,42,43) have suggested the use of hydrochloric or sulfuric acid in combination with other extractants for dissolving that portion of the soil phosphorus most closely correlated with plant absorption. Metson (25), Nelson et al. (28) and Peech (32) have thoroughly reviewed the literature on the subject, and the reader is referred to these references for a more complete and thorough discussion.

---

[1] Assistant Agronomist and Head, Department of Agronomy, respectively. The authors are indebted to J. G. Kowalczuk, Assistant Chemist, Louisiana Agricultural Experiment Station, for the total phosphorus analyses appearing in Table 1.

[2] Figures in parentheses refer to Literature Cited, pp. 28-30.

In recent years much has been written stressing the fact that "available" soil phosphorus occurred in more than one form. Bray and Kurtz (7) found, with untreated Corn Belt soils, that below pH 6 "adsorbed" forms of phosphate were relatively more abundant than at higher pH values; moreover, added soluble phosphates changed into these forms, whereas added acid-soluble forms, such as rock phosphate, were generally dissolved and also increased the "adsorbed" forms. Above pH 6 the trend was just the opposite, the acid-soluble forms being more stable. Kurtz et al. (20) found the "replacing" ability of anions for "adsorbed" or "sorbed" phosphorus to be in the increasing order: chloride, sulfate, thiocyanate, acetate, borate, bicarbonate, citrate, oxalate, fluoride. Consequently, in view of the high efficiency of the fluoride ion in dissoving phosphorus, Bray (7) suggested the use of ammonium fluoride together with hydrochloric acid as an extractant of soil phosphorus. Smith and Cook (38) correlated growth response of wheat with chemically measured "available" phosphorus on several Michigan soils. They found that it was apparently necessary to remove "adsorbed P" by extractants containing fluoride to obtain a successful chemical measure of "available P".

It has long been recognized that significant proportions of the total soil phosphorus occur in organic combination. Investigators (3, 9,31) have shown that the organic phosphorus fraction amounts in some cases to more than half of the total phosphorus in the surface six inches. Eid et al. (12) found that, at a soil temperature of 20°C. availability of soil phosphorus to plants depended on a fraction of the inorganic phosphorus. At a temperature of 35°C., however, the availability depended on a fraction of organic phosphorus. Thompson et al. (39) showed that the amounts of organic phosphorus mineralized during incubation at 40°C. ranged from — 4 to 45 ppm. These results constitute circumstantial evidence for the importance of organic phosphorus as a source of phosphorus in plant nutrition.

Some information is available on the range in phosphorus contents of the various soils in the sugar cane area of Louisiana. Holmes (17) used chemical methods as a means of evaluating the fertility level of cane soils. From a comparison of the results of chemical methods with crop responses to added fertilizers, Reed and Sturgis (34) assigned values below which plant food deficiencies were indicated and at which responses would be expected from application of fertilizers.

EXPERIMENTAL

Soils and Soil Material

The soils of the sugar cane area are relatively immature. The geologically older soils are on the Pleistocene Mississippi terraces. The Richland and Olivier series are representative of this area. Soils of the Jeanerette and Iberia series, which are geologically younger and more fertile, were developed from slack-water deposits and occur on low-lying stream terraces probably formed by the Mississippi River and its distributaries in the late Pleistocene or the early Recent. The Cypremort, Patoutville and Baldwin series also occur on stream terraces probably formed by the Mississippi River and its distributaries in the late Pleistocene or the early Recent, but the sediments from which the soils were derived show indications that they have been reworked.

A greater percentage of sugar cane is grown on the more fertile Recent alluvial soils of the Mississippi and Red River bottoms. The Commerce and Mhoon series are alluvial soils derived from Mississippi alluvium and are found in the Mississippi River flood plain from southern Missouri to southern Louisiana. The Yahola series are reddish calcareous alluvial soils with sandy subsoils that occur in the flood plain of the Red River and its distributaries. Detailed descriptions of the soil types studied are given in Soil Survey Reports, Division of Soil Survey, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.

The response of sugar cane to additions of fertilizer phosphorus was obtained from field experiments which were conducted on representative soil types in the sugar cane area of Louisiana. The trials were conducted over a period of 4 years. The treatments were placed in randomized blocks and replicated. The plot size chosen at each location was approximately 0.1 acre, which was sufficient to yield at least a sling of cane. Fertilizers were mixed from ammonium nitrate, 20 per cent superphosphate and 60 per cent muriate of potash. The fertilizers were applied in the off-bar furrow. The treatments on plant and stubble cane were as shown on Page 6. Three rates of nitrogen were applied to both plant and stubble cane, but lower rates were used on plant than on stubble cane. One rate of P_2O_5 and one rate of K_2O were used for both plant and stubble cane. The response of sugar cane to fertilizer phosphorus was measured by the increase in yield of N-P-K treatments over the yield received from N-K treatments.

Fertilizer Treatments Used in the Field Experiments

Pounds per acre N-P_2O_5-K_2O, applied to plant cane	Pounds per acre N-P_2O_5-K_2O, applied to stubble cane
0-0-0	0-0-0
40-0-0	80-0-0
40-0-60	80-0-60
40-40-60	80-40-60
60-0-0	100-0-0
60-0-60	100-0-60
60-40-60	100-40-60
80-0-0	120-0-0
80-0-60	120-0-60
80-40-60	120-40-60

Samples of the A and B horizons at 32 locations in sugar cane fields where fertility studies were being conducted were taken for analysis. All samples were air dried, pulverized and passed through a 2 mm. sieve. Gravels and concretions larger than 2 mm. in diameter were discarded. Moisture in the air-dry sample was determined and all calculations were made to the oven-dry weight basis.

EVALUATION OF VARIOUS METHODS

The extraction and determination by means of commercial "kits" were tried. The Morgan (26) "Universal" system and the LaMotte system, though widely used in other regions of the United States, did not extract measurable quantities of phosphorus from high phosphorus-fixing soils of the Pleistocene Mississippi terraces. The extraction of phosphorus by the Truog (40) laboratory procedure was also attempted. Although more usable, in that phosphorus values from the Recent alluvial soils could be, in some measure, correlated with crop yields, this method failed to extract proportionately as much soil phosphorus as the crop roots absorbed from the Pleistocene terrace soils.

Various workers have expressed a preference for 0.1 N hydrochloric or 0.1 N sulfuric acid as extracting solutions for the estimation of phosphate availability on soils of known fertilizer treatment and crop performance. Weeks and Karraker (42), Nelson et al. (28) and Metson (25) have thoroughly reviewed the literature on the subject. Reed and Sturgis (34) used 0.05 N hydrochloric acid as extractant with some degree of success in the sugar cane area of Louisiana. The ratio of soil to extracting solution used was 1:100. While these extracting solutions appeared to have some promise, results indicated that the phosphorus values received from high phosphorus-fixing soils were too low to be correlated with crop response to added fertilizer phosphorus. Furthermore, there were indications that the phosphorus values received from the Recent alluvial soils tended to be higher than they should be for correlation with field responses, particularly when a wide soil to extractant ratio was used.

DEVELOPMENT AND EVALUATION OF NEW METHOD

A further search for a suitable extractant showed that the procedures of Bray and his associates (6,7,8) might be of much value. The "adsorbed" and combined "adsorbed" and acid-soluble phosphorus procedures of Bray and Dickman (6,8) gave values on Pleistocene terrace soils which could be more easily correlated with crop response than any of the other procedures tried. By further investigation of the Bray methods (7), it was found that the 0.1 N HCl plus 0.5 N NH_4F solution, Bray 4 procedure, gave results with the Pleistocene terrace soils which indicated that more soil phosphorus was being extracted than the crop roots absorbed. Further, it was found that the Bray 2A procedure (7), 0.1 N HCl + 0.03 N NH_4F, when used at a soil to extracting solution ratio of 1:7, did not dissolve the difficultly extractable or "adsorbed" phosphorus with as great efficiency as did the Bray 4 procedure (7) or the Bray combined "adsorbed" and acid-soluble procedures (6,8). When the higher concentrations of fluoride are used, the fluoride ion must be removed before the molybdenum blue color can be developed unless the final solution is diluted to less than 0.03 N in F^-. In order to avoid this difficulty, the decision was made to use an extractant consisting of 0.1 N HCl and 0.03 N NH_4F, to vary the ratio of soil to extracting solution from 1:10 to 1:100 and to vary the shaking time from 5 minutes to 30 minutes, and then to select, from these variations, a soil:solution ratio which, when combined with a shaking time of sufficient duration, would approximately duplicate the the phosphorus extraction of the 0.1 N HCl plus 0.5 N NH_4F.

Samples of the A and B horizons of a Richland silt loam, Olivier silt loam, Commerce very fine sandy loam and Mhoon silt loam were chosen for this study. These soils represent extreme variations among the soils to be studied. The Commerce and Mhoon series represent soils from which phosphorus is easily extractable. The Richland and Olivier series represent soils from which phosphorus is extracted with more difficulty and soils which are relatively high in their abilities to fix phosphorus. Portions of the results of this study are shown in Figures 1 and 2. The amounts of phosphorus extracted from the Commerce and Mhoon soils by the 1:10, 1:25 and 1:40 soil:solution ratios indicate that one is extracting the same form or forms of phosphorus.

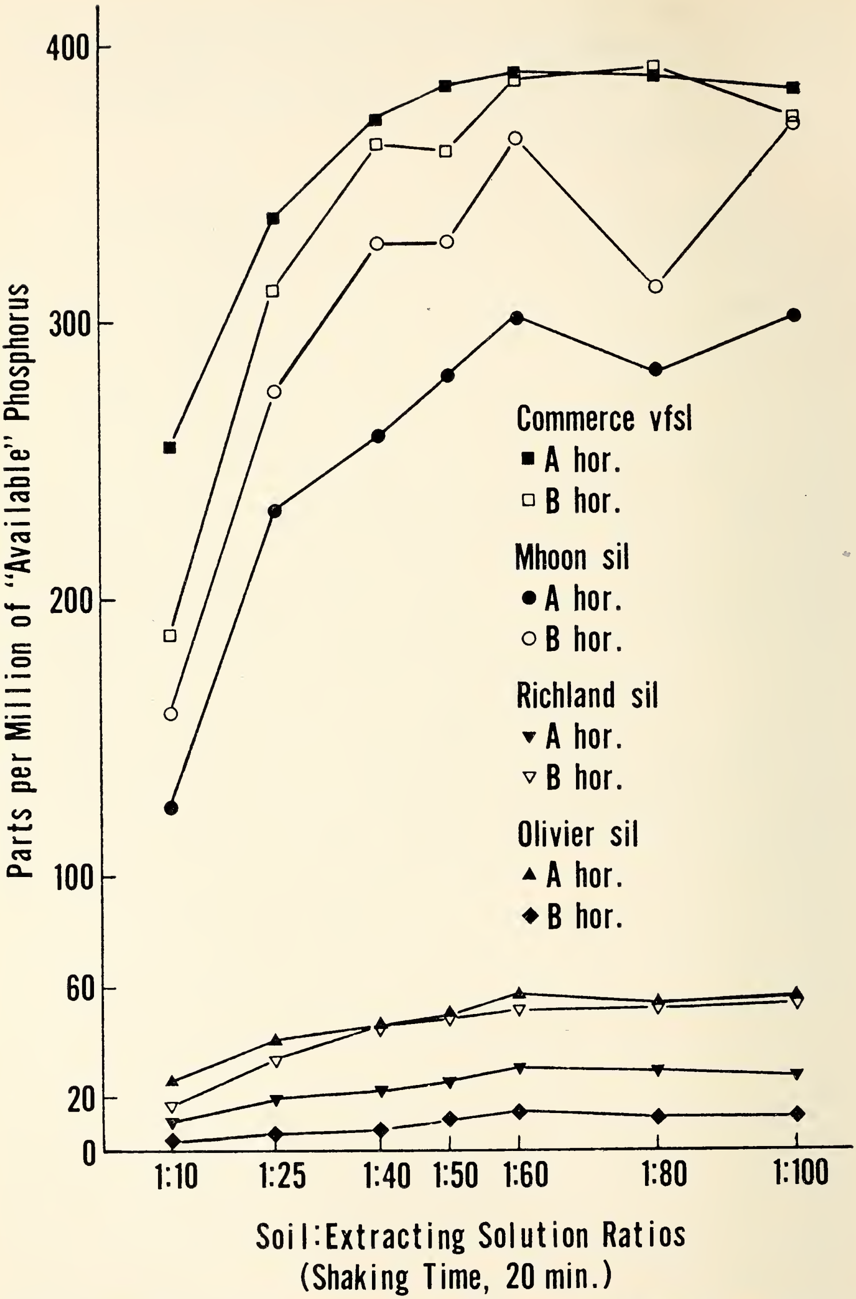


Figure 1.—Effect of soil:extracting solution ratio on the phosphorus dissolved with the proposed method.

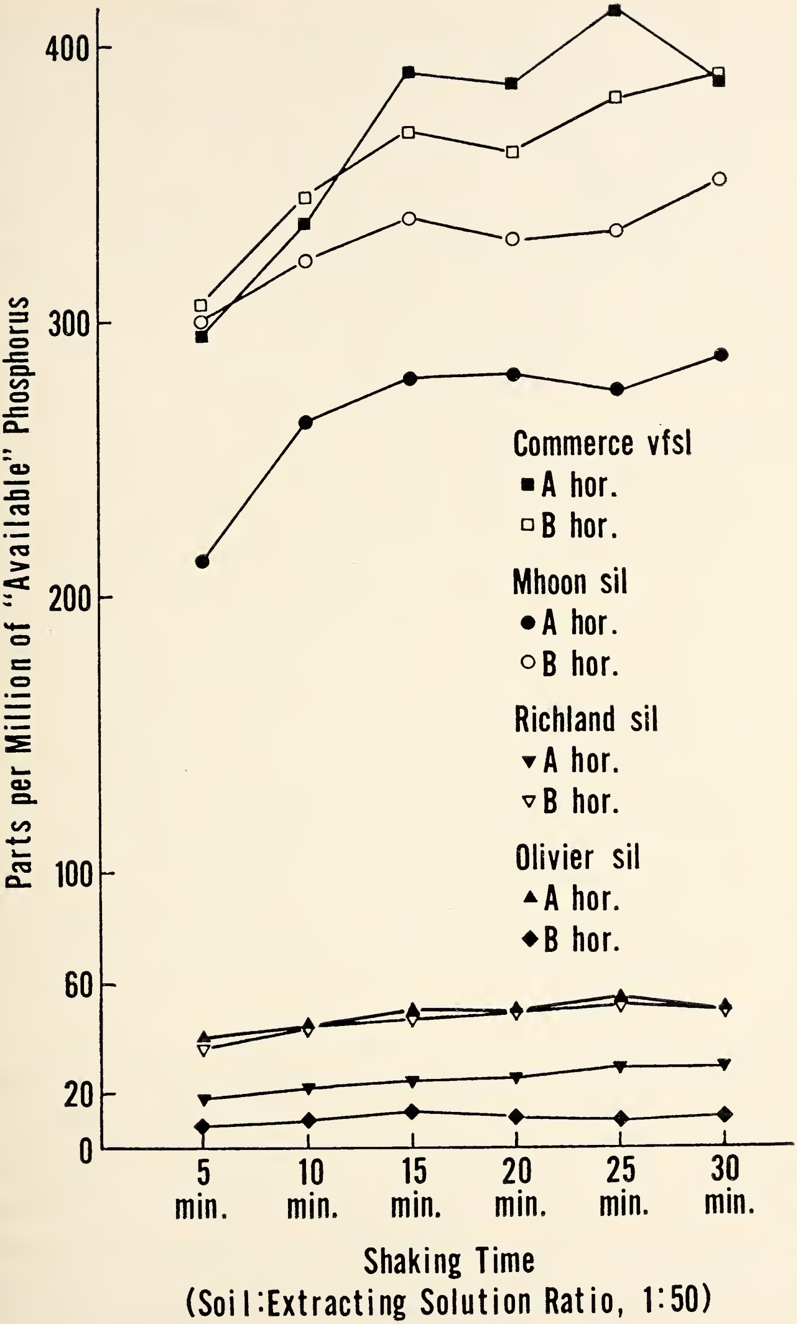


Figure 2.—Effect of shaking time on the phosphorus dissolved with the proposed method.

It is thought these forms are largely the easily acid-soluble or calcium phosphates. The 1:50, 1:60 and 1:80 soil:solution ratios seem to be extracting additionally different forms. These forms are possibly iron phosphates, aluminum phosphates, complex silico-phosphates and primary phosphorus minerals. Since these phosphorus containing compounds are only slightly soluble, their solubilities can be exceeded very easily and their formation may cause fixation of phosphorus during extraction unless either the extracting solution is sufficiently strongly buffered or the ratio of soil to extracting solution is wide enough to prevent it. At the above soil:solution ratios, there are evidences of possible re-fixation of phosphorus during the extraction. As the ratio of soil to extracting solution was widened from 1:80 to 1:100, apparently the soil:solution ratio became wide enough to prevent re-fixation of phosphorus during extraction. The amounts of phosphorus extracted from the Richland and Olivier soils, on the other hand, give indications that most of the inorganic phosphorus occurs as the more difficultly soluble or "adsorbed" forms of phosphorus. These forms are thought to be iron and aluminum phosphates, phosphates bound or adsorbed on the surfaces of hydrated iron and aluminum oxides and phosphates adsorbed on clay surfaces. A 1:40 soil:solution ratio, if shaken for 15 to 20 minutes, seemed to consistently give the best results with the Commerce and Mhoon soils, whereas a 1:60 soil:solution ratio, if shaken for the same period of time, seemed to consistently extract larger amounts of the more difficultly soluble or "adsorbed" phosphorus from soils relatively low in easily soluble phosphorus. The Bray extracting solution, 0.1 N in HCl and 0.03 N in NH_4F, used at a ratio of 1 part of soil to 50 parts of extractant and shaken for 20 minutes was selected as the method of extraction which better characterizes the amounts of soil phosphorus that could be more closely correlated with plant absorption on soils of both the Recent alluvial and Pleistocene Mississippi terrace areas.

The usual method (41) for the colorimetric determination of phosphorus is subject to interference from soluble ferric iron, silicates and arsenates. Serious interference is not expected from arsenic since it is usually not present in soil material in an appreciable amount. Soluble ferric iron and silicates may cause serious errors unless time consuming steps are taken to combat their interference. A review of literature revealed several promising procedures which might overcome the harmful effects of soluble ferric iron and silicates. The procedure of Farber and Youngburg (14), which is a modification of both the Truog and Meyer (41) and Kuttner and Lichtenstein (21) procedures, differs from the Truog and Meyer procedure mainly in the final concentrations of H_2SO_4, ammonium molybdate and stannous chloride. Acid extracts obtained from extracting soil with a hydrochloric acid extracting agent contain large quantities of chlorides which are known to interfere with maximum color development and to cause earlier fading of color. This is especially true when the sulfate containing reagents of Truog and Meyer and Farber and Youngburg are used. For a given quantity of phosphorus the Farber and Youngburg method produces a slightly deeper color and fading is slightly less rapid than with the Truog and Meyer procedure. The ability of this method of color development to overcome the harmful effects of soluble ferric iron and silicates was less than expected; consequently, the procedure of Farber and Youngburg, though definitely an improvement over that of Truog and Meyer, was rejected.

The hydrazine sulfate procedure of Muir (27) was tried next. In this procedure, phosphorus was determined by the blue color formed with sodium molybdate in acid solution and aqueous hydrazine sulfate. Interference from soluble silicates was controlled effectively by use of tartaric acid. The color is stable for at least 24 hours. Unfortunately, this method is not sufficiently sensitive for use on soil extracts possessing low concentrations of phosphorus.

The isobutyl alcohol method of Martin and Doty (22) was then studied. The procedure was long and tedious and was abandoned after it was discovered that known quantities of inorganic phosphorus added to extracts of some soils could not be completely recovered.

In a continuation of these studies the Parks et al. (30) adaptation of the 1,2,4-aminonaphtholsulfonic acid procedure of Fiske and Subbarow (15), was tried. As was the case with the aforementioned hydrazine sulfate procedure for the development of the reduced phosphomolybdate blue color, this method was not adequately sensitive for use with extracts possessing low concentrations of phosphorus.

The procedure of Bray and his co-workers (6,7,8) had been used with much more success, but there was still some difficulty, though not quite as bothersome as with some of the procedures discussed, from interference of soluble ferric iron and silicates. Finally, the procedure of Mehta et al. (24), which differs from the Bray procedure mainly in the increased quantity of stannous chloride, was tried with excellent results. The stannous chloride concentration used in this procedure permits the determination of phosphorus in the presence of the concentrations of iron and silica brought into solution. The concentration of stannous chloride can either be increased or decreased to suit the need, provided that a sufficient excess is present and that a calibration curve is prepared with the particular concentration used.

METHOD PROPOSED

Because of the difficulties involved in the use of existing procedures, it seemed desirable to develop a different method which would dissolve a larger proportion of the more difficultly extractable phosphorus from the Pleistocene terrace soils. A modified method for extracting "available" or easily-soluble phosphorus is proposed. Except for modifications, this procedure is identical with the Bray 2A method (7) for extracting the combined "adsorbed" and acid-soluble phosphorus fractions. Soil was extracted for 20 minutes with 0.1 N hydrochloric acid plus 0.03 N ammonium fluoride in a ratio of 1 part of soil to 50 parts of extracting solution. The suspension was filtered. Aliquots were taken and the molybdenum blue color developed according to Mehta et al. (24).

CHEMICAL PROCEDURE

Total phosphorus was determined by the procedure outlined by Robinson (35) which was modified to use the Beckman Model DU Spectrophotometer for the colorimetric determination of phosphorus. Organic phosphorus was determined by the procedure of Mehta et al. (24). Soil pH was determined with the glass electrode assembly using a soil to water ratio of 1:1. Total nitrogen was determined by the Gunning-Hibbard method modified to use boric acid for absorption of the ammonia as suggested by Meeker and Wagner (23). Total carbon was determined by the method recommended by A. O. A. C. (1). Inorganic carbon was determined by the method of Erickson et al. (13). At pH values of 6.5 and above, the differences between the value found for total carbon and the value found for carbonates was taken as a measure of organic carbon. For those soils with pH values below 6.5, the value found for total carbon was taken as a measure of organic carbon.

Easily-soluble or "available" phosphorus was extracted by various methods. The ammonium fluoride and ammonium fluoride with acid extractions of the phosphorus fractions were accomplished by the procedures outlined by Bray and Dickman (6,8) modified to eliminate fluoride interference in the molybdenum blue reaction as suggested by Kutrz (19). Phosphorus was also extracted by Truog's laboratory method (40) and included for comparison with other methods. For additional comparisons, the soils were extracted with 0.1 N sulfuric acid and 0.1 N hydrochloric acid, in each case using a ratio of 1 part of soil to 100 parts of extracting solution. The procedure of Truog and Meyer (41) was used for the colorimetric determination of phosphorus

TABLE 1.—Total phosphorus, organic phosphorus and related data on Red River alluvial and Mississippi River alluvial soils and Pleistocene Mississippi terrace soils

Sample nos. and horizons	Soil type †	Total P	Organic P	Organic P as per cent of total P	0.10 N HCl + 0.03 N NH_4F P	pH	Total N	Organic C
		ppm.	ppm.	%	ppm.		%	%
1, A	Yahola vfsl	352	30	9	230	6.7	0.048	0.504
B		385	42	11	240	7.9	0.033	0.304
2, A	Commerce vfsl	583	20	3	386	6.2	0.064	0.708
B		549	41	7	362	7.2	0.047	0.451
3, A	Commerce vfsl	595	25	4	347	6.0	0.065	0.693
B		534	35	7	331	7.3	0.058	0.551
4, A	Mhoon l	539	122	23	252	6.9	0.076	0.761
B		637	227	36	310	7.6	0.063	0.623
5, A	Mhoon l	530	102	19	253	6.8	0.078	0.790
B		636	41	6	347	7.3	0.069	0.680
6, A	Mhoon l	585	65	11	265	6.9	0.076	0.783
B		643	19	3	349	7.9	0.041	0.416
7, A	Mhoon sil	770	422	55	306	6.0	0.132	1.386
B		743	262	35	316	6.9	0.099	0.975
8, A	Mhoon sil	635	73	11	256	6.2	0.097	0.971
B		650	52	8	319	7.2	0.054	0.508
9, A	Mhoon sicl	826	385	47	343	6.4	0.126	1.279
B		786	347	44	381	6.7	0.096	0.975
10, A	Mhoon sicl	833	94	11	336	6.3	0.128	1.380
B		746	64	9	325	6.8	0.081	0.758
11, A	Cypremort l	285	35	12	58	6.5	0.085	0.910
B		237	42	18	21	6.2	0.061	0.631

TABLE 1.—Total phosphorus, organic phosphorus and related data on Red River alluvial and Mississippi River alluvial soils and Pleistocene Mississippi terrace soils—Continued

Sample nos. and horizons	Soil type †	Total P	Organic P	Organic P as per cent of total P	0.10 N HCl + 0.03 N NH_4F P	pH	Total N	Organic C
		ppm.	ppm.	%	ppm.		%	%
12, A	Cypremort l	489	51	10	215	6.2	0.075	0.831
B		350	10	3	107	5.8	0.052	0.487
13, A	Cypremort l	507	72	14	227	6.2	0.078	0.779
B		421	41	10	118	5.6	0.049	0.518
14, A	Baldwin sil	438	245	56	109	5.4	0.104	1.061
B		373	94	25	53	5.6	0.062	0.532
15, A	Baldwin sil	625	371	59	205	5.8	0.115	1.206
B		559	250	45	145	5.9	0.092	0.927
16, A	Baldwin sil	647	93	14	195	5.8	0.107	1.190
B		560	83	15	169	6.0	0.077	0.776
17, A	Baldwin sicl	508	157	31	108	5.4	0.124	1.547
B		316	32	10	21	5.0	0.084	0.896
18, A	Baldwin sicl	587	166	28	101	4.9	0.156	1.519
B		364	21	6	65	5.6	0.073	0.629
19, A	Baldwin sicl	558	167	30	80	4.8	0.150	1.452
B		373	32	9	49	5.2	0.066	0.568
20, A	Jeanerette l	478	92	19	191	6.8	0.095	1.140
B		449	20	4	158	7.6	0.056	0.605
21, A	Jeanerette l	477	10	2	228	7.6	0.077	0.886
B		499	41	8	247	7.8	0.064	0.672
22, A	Jeanerette l	446	61	14	173	7.2	0.081	0.907
B		498	10	2	270	7.9	0.041	0.426

TABLE 1.—Total phosphorus, organic phosphorus and related data on Red River alluvial and Mississippi River alluvial soils and Pleistocene Mississippi terrace soils—Continued

Sample nos. and horizons	Soil type †	Total P	Organic P	Organic P as per cent of total P	0.10 N HCl + 0.03 N NH_4F P	pH	Total N	Organic C
		ppm.	ppm.	%	ppm.		%	%
23, A	Jeanerette l	461	51	11	182	7.4	0.093	1.042
B		498	35	7	229	7.7	0.051	0.517
24, A	Iberia sil	466	93	20	96	6.0	0.117	1.299
B		487	39	8	183	7.1	0.056	0.588
25, A	Iberia sicl	469	210	45	112	6.7	0.173	2.024
B		431	10	2	143	7.5	0.087	0.877
26, A	Iberia sic	580	170	29	136	6.4	0.144	1.623
B		509	118	23	102	7.5	0.102	1.112
27, A	Patoutville sil	283	41	14	31	5.4	0.073	0.716
B		366	20	5	28	5.9	0.039	0.351
28, A	Richland sil	435	132	30	28	5.6	0.083	0.838
B		481	62	13	60	5.3	0.065	0.527
29, A	Richland sil	528	264	50	41	5.1	0.117	1.508
B		348	72	21	28	5.0	0.079	0.707
30, A	Richland sil	524	267	51	40	5.3	0.117	1.436
B		373	67	18	25	5.2	0.068	0.612
31, A	Olivier sil	425	142	33	41	5.4	0.096	0.946
B		306	113	37	25	5.4	0.084	0.690
32, A	Olivier sil	456	91	20	51	5.3	0.105	1.020
B		305	51	17	17	5.3	0.082	0.664

†vfsl=very fine sandy loam; l=loam; sil=silt loam; sicl=silty clay loam; sic=silty clay.

in the 0.1 N sulfuric acid extracts, whereas the procedure of Mehta et al. (24) was used for developing the molybdenum blue color in the 0.1 N hydrochloric acid extracts. Except as indicated, phosphorus in aliquots of the soil extracts was determined colorimetrically by use of the Fisher colorimeter fitted with a 650 millimicron filter. Where the extracts or diluted aliquots in which phosphorus was to be determined were colored, the Dyer and Wrenshall (11) modification was employed.

The "available" or easily-soluble phosphorus extracted from a wide range of soils by the method proposed and the other chemical methods referred to above was compared to the response of sugar cane to fertilizer phosphorus measured in field experiments.

RESULTS AND DISCUSSION

Total phosphorus, organic phosphorus and other related properties for the representative soils studied are shown by data in Table 1. Total phosphorus varies from 283 ppm. of P in the Patoutville silt loam, a Pleistocene terrace soil, to 833 ppm. of P in the Mhoon silty clay loam, a Recent alluvial soil. Organic phosphorus varies from 10 ppm. of P in the Jeanerette loam to 422 ppm. of P in Mhoon silt loam. The organic phosphorus fraction amounts to as little as 2 per cent of the phosphorus in Jeanerette loam and as much as 55 per cent in Mhoon silt loam. In soils low in total phosphorus, organic phosphorus amounts to a relatively higher percentage of the phosphorus, but the organic phosphorus fraction apparently contributes relatively little available phosphorus. The combined easily-soluble and "adsorbed" phosphorus values obtained by the proposed method are also included in this table for comparative purposes. From soils of the Recent alluvial area, samples 1-10, this method extracted approximately 40-66 per cent of the total phosphorus, while 6-48 per cent of the total phosphorus was extracted from soils of the Pleistocene Mississippi terrace area, samples 11-32. The Cypremort, Baldwin, Jeanerette and Iberia series of soils have been included in this group; however, they are intermediate in development between more representative Pleistocene Mississippi terrace soils such as Lintonia, Richland and Olivier and the Recent alluvial soils of the Yahola, Commerce and Mhoon series.

Per cent total nitrogen, per cent organic carbon and pH are other related characteristics of the soils also given in Table 1. In the A horizons of the soils the organic phosphorus content was associated with the content of total nitrogen, the content of organic carbon and the pH, as indicated by the equations

$$P = 58 + 0.2051N - 21.6pH \qquad [1]$$

$$P = 138 + 0.0164C - 29.9pH \qquad [2]$$

where $P = $ ppm. organic phosphorus, $N = $ ppm. total nitrogen and $C = $ ppm. organic carbon. The equations show that organic phosphorus was associated positively with total nitrogen and organic carbon. All regression coefficients were significant.

The ratios of total nitrogen and organic carbon to organic phosphorus were associated positively with pH. The equations expressing these relationships are

$$N/P = 284 - 98\text{pH} + 8.6(\text{pH})^2 \qquad [3]$$

$$C/P = 3364 - 1162\text{pH} + 102.5(\text{pH})^2 \qquad [4]$$

All regression coefficients were highly significant.

The regressions of total nitrogen and organic carbon on organic phosphorus are indicated by the equations

$$N = 1.67P + 792 \qquad [5]$$

$$C = 18.88P + 8397 \qquad [6]$$

All regression coefficients were highly significant.

Table 2 gives the amounts of easily-soluble or "available" phosphorus extracted from these same soils by various methods and the responses of sugar cane to fertilizer phosphorus. It is apparent from the data presented here that the Recent alluvial soils, of the Yahola, Commerce and Mhoon series, are soils from which phosphorus is easily extractable. Soils in these series are high yielding and give little response to added fertilizer phosphorus. The Pleistocene Mississippi terrace soils, on the other hand, are soils from which phosphorus is extracted with more difficulty. These soils, which are relatively low in available phosphorus, would be expected to respond to applications of fertilizer phosphorus. The "adsorbed" phosphorus fraction in the terrace soils should be taken into account in assessing the level of "available" phosphorus and in determining the probability of response of a soil to fertilizer phosphorus. "Adsorbed" phosphorus is of particular importance in evaluating the "available" phosphorus in soils of the Richland, Olivier, Patoutville and Baldwin series. It is of much less importance in estimating the "available" phosphorus in the alluvial soils of the Yahola, Commerce and Mhoon series. As indicated in Table 2, responses to the application of fertilizer phosphorus to sugar cane can be expected if the soil tests show less than 100 ppm. of P by the Bray combined "adsorbed" and acid-soluble method, less than 50 ppm. of P by the Truog method, less than 100 ppm. of P by the 0.1 N hydrochloric acid method or less than 75 ppm. of P by the proposed modified method.

Laboratory methods can be expected to give no more than relative indications of the phosphorus status, and their practical use as a basis for successful fertilizer recommendations depends very largely on

TABLE 2.—Phosphorus extracted by various methods from Red River alluvial and Mississippi River alluvial soils and from Pleistocene terrace soils as related to the response of sugar cane to fertilizer phosphorus

Sample nos. and horizons	Bray Fractions			Truog's method P	0.10 N H_2SO_4 P	0.10 N HCl P	0.10 N HCl + 0.03 N NH_4F P	Response of sugar cane to fertilizer P
	"Adsorbed" P	Acid-soluble P	Combined "adsorbed" and acid-soluble P					
	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	Tons/A.
1, A	36	82	118	76	207	209	230	0.26†
B	20	101	121	87	217	267	240	
2, A	53	98	151	113	391	410	386	−0.85†
B	28	133	161	152	390	369	362	
3, A	49	136	185	125	391	406	347	−0.51‡
B	21	175	196	143	346	369	331	
4, A	24	130	154	81	267	287	252	−0.35‡
B	16	195	211	137	356	343	310	
5, A	23	127	150	99	273	290	253	0.20‡
B	28	194	222	163	382	406	347	
6, A	18	130	148	118	278	281	265	0.28‡
B	11	203	214	169	400	425	349	
7, A	50	206	256	147	385	397	306	0.10†
B	35	226	261	151	366	361	316	
8, A	26	109	136	115	271	288	256	0.40‡
B	18	114	132	111	340	374	319	
9, A	62	198	260	149	321	357	343	0.24‡
B	51	222	273	161	352	399	381	

529

1234

TABLE 2.—Phosphorus extracted by various methods from Red River alluvial and Mississippi River alluvial soils and from Pleistocene terrace soils as related to the response of sugar cane to fertilizer phosphorus—Continued

Sample nos. and horizons	Bray Fractions			Truog's method P	0.10 N H_2SO_4 P	0.10 N HCl P	0.10 N HCl + 0.03 N NH_4F P	Response of sugar cane to fertilizer P
	"Adsorbed" P	Acid-soluble P	Combined "adsorbed" and acid-soluble P					
	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	Tons/A.
10, A	56	205	261	155	379	366	336	0.21‡
B	44	238	282	184	280	359	325	
11, A	26	35	61	13	40	48	58	3.40**,‡
B	7	17	24	11	7	10	21	
12, A	41	148	189	128	148	160	215	0.74†
B	22	54	76	46	58	73	107	
13, A	52	106	158	116	184	186	227	0.48‡
B	34	47	81	42	69	97	118	
14, A	63	32	95	12	51	68	109	0.99*,‡
B	30	14	44	5	21	28	53	
15, A	92	98	190	45	134	139	205	0.52‡
B	56	66	122	36	97	120	145	
16, A	68	93	161	45	120	183	195	0.38‡
B	57	71	128	45	101	156	169	
17, A	67	34	101	24	58	96	108	0.86*,†
B	11	13	24	6	6	15	21	
18, A	43	26	74	26	66	84	101	0.48†
B	26	25	51	17	37	53	65	

4,365
2,293
1675

TABLE 2.—Phosphorus extracted by various methods from Red River alluvial and Mississippi River alluvial soils and from Pleistocene terrace soils as related to the response of sugar cane to fertilizer phosphorus—Continued

Sample nos. and horizons	Bray Fractions			Truog's method P	0.10 N H_2SO_4 P	0.10 N HCl P	0.10 N HCl + 0.03 N NH_4F P	Response of sugar cane to fertilizer P
	"Adsorbed" P	Acid-soluble P	Combined "adsorbed" and acid-soluble P					
	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	Tons/A.
19, A	52	29	81	22	31	45	80	1.09*,†
B	20	31	51	9	14	16	49	
20, A	86	85	171	93	187	217	191	0.21‡
B	17	82	99	51	141	175	158	
21, A	76	84	160	97	259	265	228	0.20†
B	41	96	137	89	278	295	247	
22, A	46	65	111	69	189	211	173	0.26‡
B	8	89	97	89	325	364	270	
23, A	46	89	135	91	196	213	182	0.25‡
B	14	107	121	97	254	272	229	
24, A	35	50	85	44	75	90	96	0.78*,†
B	10	113	123	105	170	180	183	
25, A	33	57	90	40	85	89	112	0.66‡
B	7	108	115	66	104	102	143	
26, A	53	72	125	49	91	98	136	0.10†
B	29	70	99	37	68	54	102	
27, A	15	20	35	5	5	7	31	3.16**,†
B	19	12	31	7	9	10	28	

TABLE 2.—Phosphorus extracted by various methods from Red River alluvial and Mississippi River alluvial soils and from Pleistocene terrace soils as related to the response of sugar cane to fertilizer phosphorus—Continued

Sample nos. and horizons	Bray Fractions			Truog's method P	0.10 N H_2SO_4 P	0.10 N HCl P	0.10 N HCl + 0.03 N NH_4F P	Response of sugar cane to fertilizer P
	"Adsorbed" P	Acid-soluble P	Combined "adsorbed" and acid-soluble P					
	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	Tons/A.
28, A	17	9	26	5	6	9	28	1.10*,‡ 4,850
B	31	25	56	14	12	14	60	
29, A	26	21	47	10	10	12	41	2.56**,† 11,284
B	9	21	30	5	5	7	28	
30, A	29	17	46	9	10	14	40	2.22**,‡ 9,788
B	11	20	31	6	3	9	25	
31, A	35	27	62	7	11	14	41	3.98**,‡
B	10	25	35	2	2	4	25	
32, A	42	29	71	8	14	18	51	2.67**,‡
B	8	16	24	1	1	3	17	

*Significant at 5 per cent level.

**Significant at 1 per cent level.

†Plant cane.

‡Stubble cane.

the degree or extent of their calibration or correlation with crop response to added fertilizer. Not over 15 to 20 per cent of the "available" phosphorus as shown by the newly proposed method can be absorbed by a sugar cane crop.

Data in Table 2 show that 0.1 N hydrochloric acid extracted more phosphorus than did 0.1 N sulfuric acid. The explanation for the apparent slightly superior ability of hydrochloric acid as an extracting solution for soil phosphorus in this case may be due to the method of color development. The procedure of Mehta et al. (24) which was used in determining phosphorus as the reduced phosphomolybdate in the hydrochloric extracts was more efficient in combating the harmful effects of soluble ferric iron and silica than was the Truog (41) procedure which was used for developing color in the sulfuric extracts.

The increases in yield due to applied fertilizer phosphorus as shown in Table 2 for all soils studied are presented graphically in Figure 3. In this figure, the response of sugar cane in tons of cane per acre due to applications of fertilizer phosphorus is correlated with pounds of "available" phosphorus per acre as determined by the proposed method. Similar types of curves were obtained from results of the 0.1 N HCl, 0.1 N H_2SO_4, the Truog laboratory and Bray combined "adsorbed" and acid-soluble procedures. These curves are presented in Figures 4 through 7. The coefficients of simple linear correlation (r) between the "available" phosphorus values (X) obtained by the different methods and the response of sugar cane to fertilizer phosphorus (Y) were calculated. These coefficients are given in Table 3 and are all statistically highly significant. However, the r value showing the simple linear correlation between "available" phosphorus by the newly proposed method and response to fertilizer phosphorus is highest in significance. It is obvious from Figures 3 through 7 that the variates are not so simply associated. Instead of being straight lines the phosphorus response curves appeared to be of the diminishing yield type. By using Snedecor's (37) curvilinear regression approach, the multiple regression equations were calculated for all chemical procedures used in the comparisons. These are also shown in Table 3 and conform to the second degree polynominal type, $Y = a - b \log X_1 + cX_2^2$, where Y is the response of sugar cane in tons of cane per acre due to applications of superphosphate, a, b and c are constants, $\log X_1$ is the common logarithm of the "available" phosphorus value and X_2^2 is the square of $\log X_1$. This equation was found to fit the data much more closely than does the linear equation, $Y = a - bX$, where X is the "available" phosphorus value in ppm. The magnitudes of the regression coefficients indicate a very high statistical

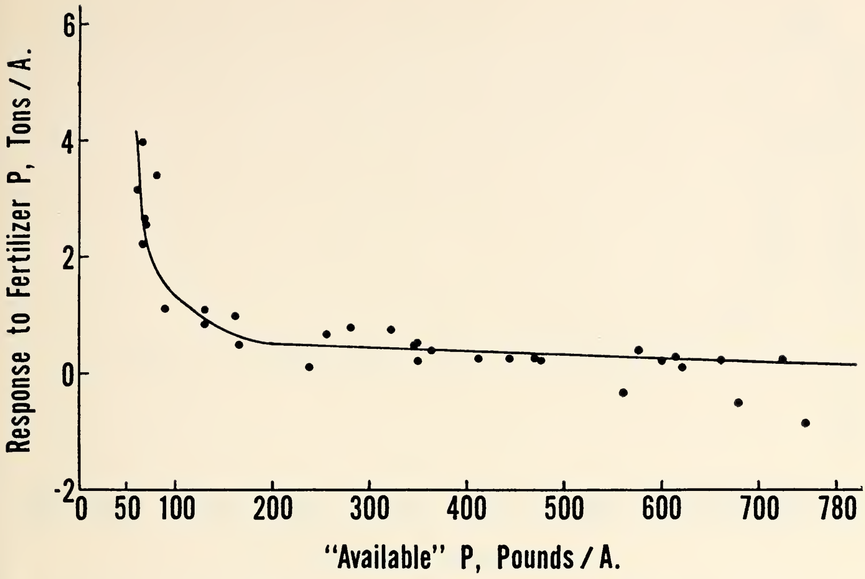


Figure 3.—Relationship between "available" phosphorus extracted with the proposed method and response of sugar cane to fertilizer phosphorus.

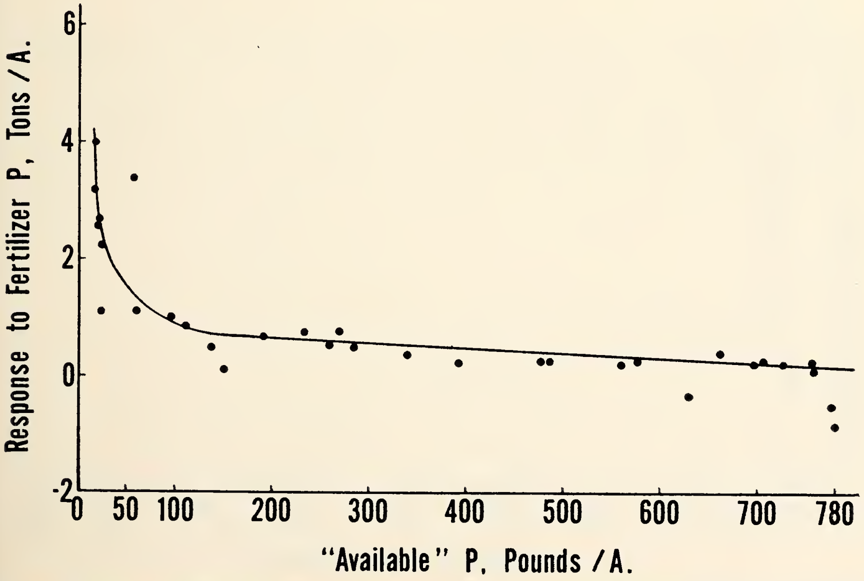


Figure 4.—Relationship between "available" phosphorus extracted with 0.1 N HCl and response of sugar cane to fertilizer phosphorus.

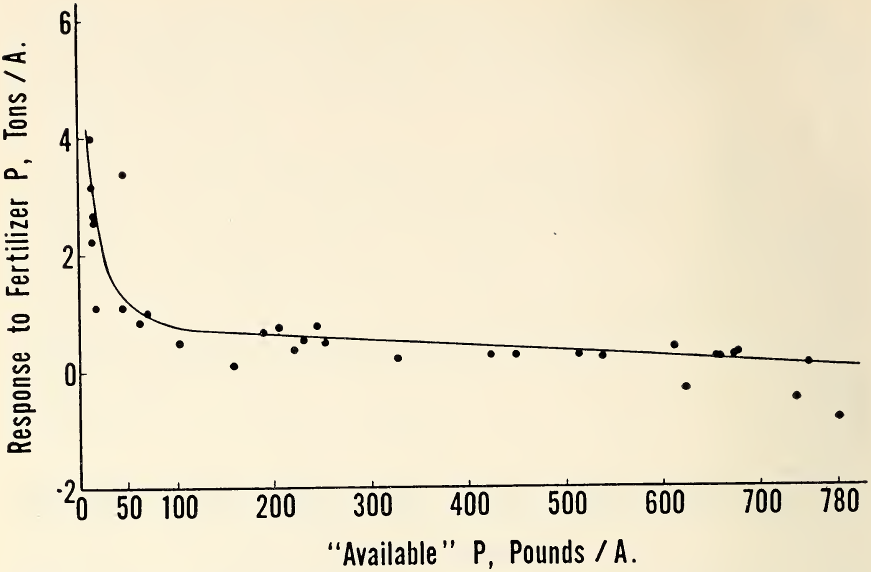


Figure 5.—Relationship between "available" phosphorus extracted with 0.1 N H_2SO_4 and response of sugar cane to fertilizer phosphorus.

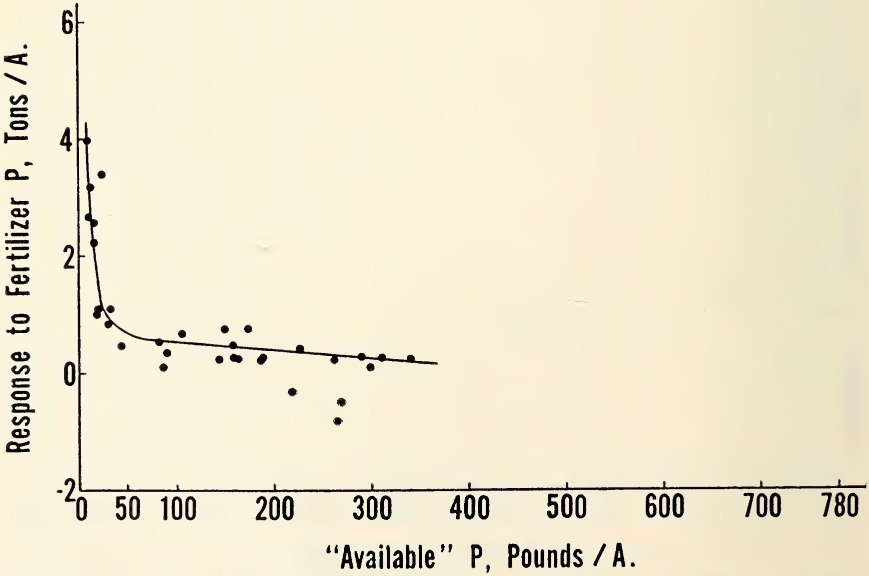


Figure 6.—Relationship between "available" phosphorus extracted with Truog's laboratory method and response of sugar cane to fertilizer phosphorus.

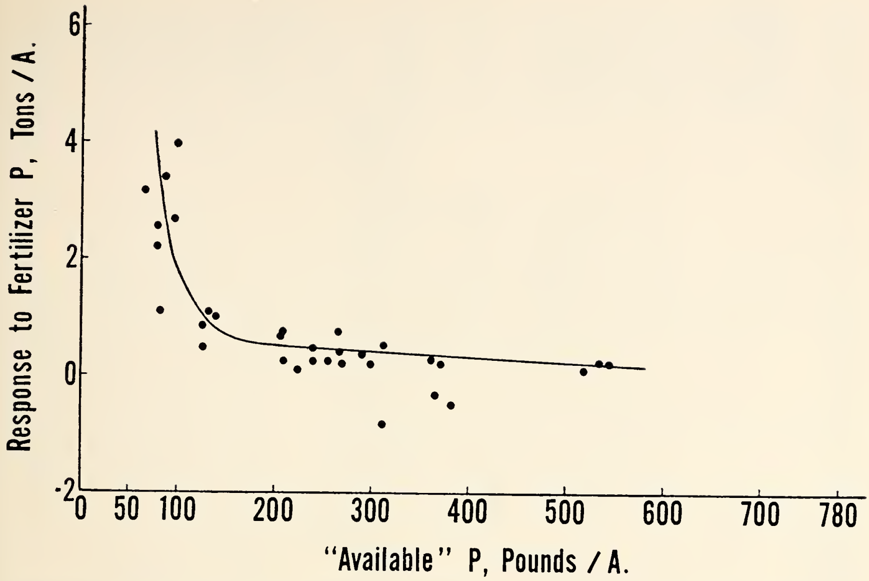


Figure 7.—Relationship between "available" phosphorus extracted with Bray combined "adsorbed" and acid-soluble procedure and response of sugar cane to fertilizer phosphorus.

significance for the relationships. It is interesting to observe the effect of curvilinearity of regression on the correlations. In every instance the coefficients of multiple correlation (R) were larger than the corresponding correlation coefficients (r) found for the linear relationship. Again using the procedures of Snedecor (37), it was found that the departure from linearity to curvilinearity of regression was highly significant in each instance.

The same approach was used with the data obtained from Pleistocene Mississippi terrace soils, samples 11-32. The results of the analysis are presented in Table 4. Very highly significant correlations were found. In every case the relationship $Y = a - b \log X_1 + cX_2^2$ gave a significantly higher index of correlation than did the correlation coefficient found for the linear relationship, $Y = a - bX$. Both the correlation coefficient (r) and the coefficient of multiple correlation (R) were higher with the results obtained from the newly proposed chemical procedure.

In a number of instances there was little difference between the correlation coefficients found for the various chemical methods. When all the soils in the investigation were considered, taking fully into ac-

TABLE 3.—Correlation coefficients, multiple regression equations and coefficients of multiple correlation for the relationship between the "available" phosphorus values (X) by different chemical procedures and response of sugar cane to fertilizer phosphorus (Y) for samples 1-32

Chemical procedures	Correlation coefficients (r)	Multiple regression equations	Coefficients of multiple correlations (R)
0.1 N HCl + 0.03 N NH_4F†	—0.7732	$Y = 17.893 - 14.2364 \log X_1 + 2.837898 X_2^2$	+0.9122
0.1 N HCl	—0.7381	$Y = 6.360 - 4.2662 \log X_1 + 0.696944 X_2^2$	+0.8838
0.1 N H_2SO_4	—0.7273	$Y = 5.376 - 3.5327 \log X_1 + 0.556406 X_2^2$	+0.8731
Truog's laboratory	—0.7085	$Y = 6.967 - 6.5954 \log X_1 + 1.586065 X_2^2$	+0.8788
Bray combined "adsorbed" and acid soluble	—0.6875	$Y = 27.918 - 24.2517 \log X_1 + 5.275972 X_2^2$	+0.8558

† Proposed method.

TABLE 4.—Correlation coefficients, multiple regression equations and coefficients of multiple correlation for the relationship between the "available" phosphorus values (X) by different chemical procedures and response of sugar cane to fertilizer phosphorus (Y) for samples 11-32

Chemical procedures	Correlation coefficients (r)	Multiple regression equations	Coefficients of multiple correlations (R)
0.1 N HCl + 0.03 N NH_4F†	—0.7762	$Y = 27.587 - 24.8101 \log X_1 + 5.644735 X_2^2$	+0.9189
0.1 N HCl	—0.6938	$Y = 6.944 - 5.1252 \log X_1 + 0.976702 X_2^2$	+0.8570
0.1 N H_2SO_4	—0.6738	$Y = 5.903 - 4.3399 \log X_1 + 0.824485 X_2^2$	+0.8456
Truog's laboratory	—0.6907	$Y = 8.625 - 9.5070 \log X_1 + 2.728684 X_2^2$	+0.8721
Bray combined "adsorbed" and acid soluble	—0.7587	$Y = 29.822 - 26.7027 \log X_1 + 6.044743 X_2^2$	+0.8143

† Proposed method.

count the practical evaluation as well as the statistical evaluation of each method used for comparison, the proposed method employing HCl and NH_4F as an extractant and employing the procedure of Mehta et al. (24) as the means of color development showed the closest relationship with crop response.

SUMMARY

Total, organic and "adsorbed" phosphorus were determined in soils of the sugar cane area of Louisiana. Easily-soluble or dilute acid-soluble phosphorus was determined by various methods and the results evaluated in relation to the growth of sugar cane.

A relatively higher percentage of the phosphorus is in organic forms in soils low in total phosphorus, but the organic fraction apparently supplies relatively little available phosphorus.

In soils of the Richland, Olivier, Patoutville and Baldwin series, developed on Pleistocene terraces, the "adsorbed" phosphorus should be taken into account in assessing the level of "available" phosphorus and in determining the probability of response of the soil to fertilizer phosphorus. "Adsorbed" phosphorus is of less importance in estimating "available" phosphorus in the Recent alluvial soils.

A chemical method for determining easily-soluble and "adsorbed" phosphorus was modified and further developed. The dilute acid-soluble and "adsorbed" phosphorus by this method has been termed "available," and it was more closely correlated with the absorption of phosphorus by the crop than was phosphorus extracted by the simpler dilute acid-soluble methods.

Responses to the application of fertilizer phosphorus to sugar cane can be expected if the "available" phosphorus values are less than 100 ppm. of P by the Bray combined "adsorbed" and acid-soluble method, less than 50 ppm. of P by the Truog method, less than 100 ppm. of P by the 0.1 N hydrochloric acid method or less than 75 ppm. of P by the proposed modified method.

Laboratory methods can be expected to give no more than relative indications of the phosphorus status of soils, and their practical use as a basis for successful fertilizer recommendations depends very largely on the degree or extent of their calibration or correlation with crop response to added fertilizer. Not over 20 per cent of the "available" phosphorus as shown by the newly proposed method can be absorbed by a sugar cane crop.

LITERATURE CITED

1. Association of Official Agricultural Chemists. Official Methods of Analysis. Seventh Edition. 910 pp., illus. Washington, D. C. 1950.
2. Baver, L. D., and Brunner, F. H. Rapid soil tests for estimating the fertility needs of Missouri soils. Missouri Agr. Exp. Sta. Bul. 404. 1939.
3. Black, C. A., and Goring, C. A. I. Organic phosphorus in soils. *In* Soil and Fertilizer Phosphorus in Crop Nutrition, Chap. V., pp. 123-152. Pierre, W. H., and Norman, A. G., editors. Academic Press, Inc., New York, N. Y. 1953.
4. Bray, R. H. A field test for available phosphorus in soils. Illinois Agr. Exp. Sta. Bul. 337. 1939.
5. Bray, R. H., and Dickman, S. R. Replacement of adsorbed phosphate from kaolinite by fluoride. Soil Sci. 52: 263-273. 1941.
6. Bray, R. H., and Dickman, S. R. Adsorbed phosphates in soils and their relation to crop responses. Soil Sci. Soc. Amer. Proc. (1941) 6: 312-320. 1942.
7. Bray, R. H., and Kurtz, L. T. Determination of total, organic and available forms of phosphate in soils. Soil Sci. 59: 39-45. 1945.
8. Dickman, S. R., and Bray, R. H. Colorimetric determination of phosphate. Ind. Eng. Chem., Anal. Ed. 12: 665-668. 1940.
9. Dickman, S. R., and DeTurk, E. E. A method for the determination of the organic phosphorus of soils. Soil Sci. 45: 29-37. 1938.
10. Dyer, B. On the analytical determination of the probably available plant food in soils. Trans. Chem. Soc. 65: 115-167. 1894.
11. Dyer, W. J., and Wrenshall, C. L. An improved method for the determination of phosphate by photoelectric colorimetry. Canadian Jour. Res. 16B: 97-108. 1938.
12. Eid, M. T., Black, C. A., and Kempthorne, O. Importance of soil organic and inorganic phosphorus to plant growth at low and high soil temperatures. Soil Sci. 71: 361-370. 1951.
13. Erickson, A. E., Li, L. C., and Gieseking, J. E. A convenient method for estimating carbonates in soils and related materials. Soil Sci. 63: 451-454. 1947.
14. Farber, J. E., and Youngburg, G. E. Determination of phosphates in water. Ind. Eng. Chem., Anal. Ed. 4: 107-109. 1932.
15. Fiske, C. H., and Subbarow, Y. The colorimetric determination of phosphorus. Jour. Biol. Chem. 66: 375-400. 1925.
16. Fraps, G. S. Active phosphoric acid and its relation to the needs of the soil for phosphoric acid in pot experiments. Texas Agr. Exp. Sta. Bul. 126. 1909.
17. Holmes, R. L. A study of the use of chemical methods as a means of evaluating the fertility of Louisiana cane soils. Unpub. M. S. thesis, Louisiana State University, Baton Rouge, La. 1937.
18. Kerr, H. W., and Von Steiglitz, C. R. The laboratory determination of soil fertility. Queensland Dept. Agr., Brisbane Tech. Commun. 9:179-203. 1938.
19. Kurtz, L. T. Elimination of fluoride interference in the molybdenum blue reaction. Ind. Eng. Chem., Anal. Ed. 14: 855. 1942.
20. Kutrz, L. T., DeTurk, E. E., and Bray, R. H. Phosphate adsorption by Illinois soils. Soil Sci. 61: 111-124. 1946.

21. Kuttner, T., and Lichtenstein, L. Micro colorimetric studies. II. Estimation of phosphorus: Molybdic acid—stannous chloride reagent. Jour. Biol. Chem. 86: 671-676. 1930.

22. Martin, J. B., and Doty, D. M. Determination of inorganic phosphate. Anal. Chem. 21: 965-967. 1949.

23. Meeker, E. W., and Wagner, E. C. Titration of ammonia in presence of boric acid. Ind. Eng. Chem., Anal. Ed. 5: 396-398. 1933.

24. Mehta, N. C., Legg, J. O., Goring, C. A. I., and Black, C. A. Determination of organic phosphorus in soils: I. Extraction method. Soil Sci. Soc. Amer. Proc. 18: 443-449. 1954.

25. Metson, A. J. Methods of chemical analysis for soil survey samples. New Zealand Dept. Sci. Ind. Res., Soil Bureau Bul. 12: 33-45. 1956.

26. Morgan, M. F. The universal soil testing system. Connecticut Agr. Exp. Sta. Bul. 392: 129-159. 1937.

27. Muir, J. W. The determination of total phosphorus in soil with particular reference to the control of interference by soluble silica. Analyst. 77: 313-317. 1952.

28. Nelson, W. L., Mehlich, A., and Winters, E. The development, evaluation and use of soil tests for phosphorus availability. *In* Soil and Fertilizer Phosphorus in Crop Nutrition, Chap. VI, pp. 153-188. Pierre, W. H., and Norman, A. G., editors. Academic Press, Inc., New York, N. Y. 1953.

29. Olson, L. S. Factors affecting the relationship between laboratory tests for soil phosphorus and crop response to applied phosphate. Soil Sci. Soc. Amer. Proc. (1946) 10: 443-445. 1947.

30. Parks, R. Q., Hood, S. L., Hurwitz, C., and Ellis, G. H. Quantitative chemical microdetermination of twelve elements in plant tissue. Ind. Eng. Chem., Anal. Ed. 15: 527-533. 1943.

31. Pearson, R. W. Determination of organic phosphorus in soils. Ind. Eng. Chem., Anal. Ed. 12: 198-200. 1940.

32. Peech, M. Chemical methods for assessing soil fertility. *In* Diagnostic Techniques for Soils and Crops, Chap. I, pp. 1-52. Kitchen, H. B., editor. American Potash Institute, Washington, D. C. 1948.

33. Peech, M., Alexander, L. T., Dean, L. A., and Reed, J. F. Methods of soil analysis for soil fertility investigations. U. S. D. A. Cir. 757. 1947.

34. Reed, J. F., and Sturgis, M. B. The use of chemical methods for the determination of available nutrients in Louisiana soils. Louisiana Agri. Exp. Sta. Bul. 313. 1939.

35. Robinson, W. O. Method and procedure of soil analysis used in the Division of Soil Chemistry and Physics. U. S. D. A. Cir. 139, rev. 1939.

36. Rubins, E. J., and Dean, L. A. A comparison of certain methods for determining readily soluble phosphorus in soils. Jour. Amer. Soc. Agron. 38: 820-823. 1946.

37. Snedecor, G. W. Statistical Methods. Fifth edition, Iowa State College Press, Ames, Iowa. 1956.

38. Smith, F. W., and Cook, R. L. A study of the relationship between chemically available phosphorus and plant growth response on several Michigan soils. Soil Sci. Soc. Amer. Proc. 17: 26-30. 1953.

39. Thompson, L. M., Black, C. A., and Zoellner, J. A. Occurrence and mineralization of organic phosphorus in soils, with particular reference to associations with nitrogen, carbon and pH. Soil Sci. 77: 185-196. 1954.

40. Truog, E. The determination of the readily available phosphorus of soils. Jour. Amer. Soc. Agron. 23: 874-882. 1930.

41. Truog, E., and Meyer, A. H. Improvement in the Denigès colorimetric method for phosphorus and arsenic. Ind. Eng. Chem., Anal. Ed. 1: 136-139. 1929.

42. Weeks, M. E., and Karraker, P. E. A comparison of various extracting solutions for measuring the availability of phosphorus in soils of known fertilizer treatment and crop performance. Soil Sci. 51: 41-54. 1941.

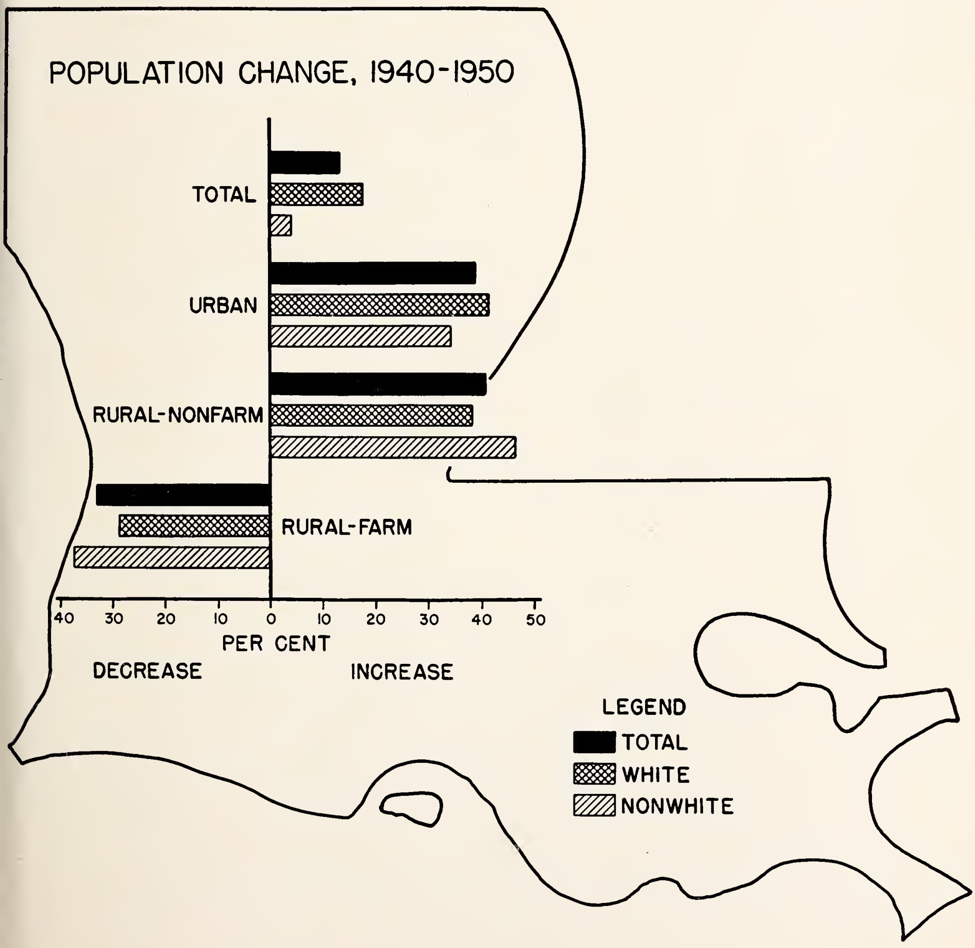
43. Wild. A. The effect of neutral salts on the retention of phosphate by clay at various pH values. Trans. Intern. Cong. Soil Sci. 4th Cong. Groningen. 1: 146-149. 1950.

lletin No. 514 June 1958

630.7
L93b

Louisiana's
Rural Population at Mid-Century

by Paul H. Price



gricultural Experiment Station
Charles W. Upp, Director

Louisiana State University and
Agricultural and Mechanical College

TABLE OF CONTENTS

Page
Introduction 5
Methodology and Procedures 5
Number and Distribution 7
Residence 10
Age Composition 13
Sex Composition 22
Racial Composition 24
Nativity 30
Educational Status 36
Marital Status 47
Occupational Status 50
Income 57
Trends 60
Summary and Conclusions 69

LIST OF TABLES

I. Population of Louisiana, by Race, and Residence, 1900 to 1950 29
II. White Population of the Parishes of Louisiana, by Nativity, 1950 31
III. Country of Birth of the Foreign-Born Population, Louisiana, 1950, by Residence 33
IV. Educational Attainment of the Population 25 years of Age and Over, by Race and Residence, Louisiana, 1950 41
V. Educational Attainment of the Rural-Farm Population 25 Years of Age and Over, by Race, Louisiana, 1950 42
VI. Marital Status of Persons 14 Years Old and Over, by Race and Residence, Louisiana, 1950 47
VII. Occupation of the Experienced Civilian Labor Force, by Sex, Louisiana, 1950 51
VIII. Occupation of the Experienced Civilian Labor Force, by Residence, Louisiana, 1950 53
IX. Occupations of Employed Persons 14 Years of Age and Over, by Sex, Race, and Residence, Louisiana, 1950 55
X. Income in 1949 of Families and Unrelated Individuals, by Race and Residence, Louisiana, 1950 58
XI. Median Income by Race, Sex, and Residence, Louisiana, 1949 59
XII. Relative and Absolute Population Changes in Louisiana, by Race and Residence, 1940 to 1950 62

LIST OF FIGURES

Number Page
1. Population Distribution, Louisiana, 1950 8
2. Density: Population Per Square Mile, Louisiana, 1950 10
3. The White Population, Louisiana, 1950, by Residence 11
4. The Nonwhite Population, Louisiana, 1950, by Residence . . 12
5. Age-Sex Pyramids, Louisiana, 1950, by Residence 14
6. Age Profiles, Louisiana, 1950, by Residence 16
7. Age Profiles, White Population, 1950, by Residence 17
8. Age Profiles, Nonwhite Population, 1950, by Residence 18
9. Age-Sex Pyramids, Urban and Rural-Farm Population, Louisiana, 1940 and 1950 19
10. Age Dependency Ratios, Rural-Farm Population, Louisiana, 1950 21
11. Sex Ratios, Rural-Farm Population, Louisiana, 1950 23
12. Negro Population, Louisiana, 1950, by Parishes 25
13. Rural-Farm Population, by Race, Louisiana, 1950 27
14. Population of Louisiana, by Race and Nativity, 1900 to 1950 35
15. Median Years of Schooling Completed, Louisiana and The United States, 1950, by Race 36
16. Median School Years Completed, Male Population, Louisiana, 1950 38
17. Median School Years Completed, Female Population, Louisiana, 1950 39
18. Median School Years Completed, Rural-Farm Population, 1950 40
19. Median Years of Schooling Completed, Louisiana, 1940 and 1950 46
20. Louisiana Population Trends:1900 to 1950, by Residence . . . 61
21. Population Change, Louisiana, 1940 to 1950, by Parishes 63
22. Population Change, White Population, Louisiana, 1940 to 1950, by Parishes 64
23. Population Change, Negro Population, Louisiana, 1940 to 1950, by Parishes 65
24. Population Change, White Rural-Farm Population, Louisiana, 1940 to 1950, by Parishes 67
25. Population Change, Nonwhite Rural-Farm Population, Louisiana, 1940 to 1950, by Parishes 68

Louisiana's Rural Population at Mid-Century

PAUL H. PRICE *
Department of Rural Sociology

INTRODUCTION

Business and governmental enterprises in modern society increasingly require population data for both their current activities and their plans for the future. This is evidenced by the fact that almost daily the Department of Rural Sociology is called upon to provide information to some organization or individual relative to the population of the state of Louisiana. In reality, demographic information has become indispensable in contemporary society. It is needed by school administrators, by health personnel, by governmental agencies, by economic planners, by agricultural extension people, by experiment station personnel, by politicians, by the clergy, by civic clubs, and by just about every other element in society. It is the purpose of this monograph to present the significant demographic facts relative to the rural people of Louisiana. Since comparisons are made with the urban and rural-nonfarm segments of the population, the analysis includes pertinent demographic findings relative to all of the state's residents. The author anticipates that this study will fill an urgent need for demographic data pertaining to Louisiana's human resources.

The Department of Rural Sociology has been engaged in population research for a quarter of a century. However, the last comprehensive study of the Department treating the general characteristics and trends of Louisiana's rural population was based on 1930 data. The past twenty years, particularly the last decade, have brought fundamental changes in the rural and urban segments of the state's population. At present, only scattered information concerning the 1950 population of Louisiana is available. This study is intended to present basic demographic findings relative to the human resources of the state at mid-century, to focus attention upon rural-urban differentials and trends, and to serve as a general demographic reference.

METHODOLOGY AND PROCEDURES

The presentation of data in this study is designed to provide a maximum of useful information in a concise manner. To accomplish this objective, wide usage has been made of maps and charts. In the manuscript, the author has attempted to point out the most significant demographic features of the people of Louisiana, leaving the more detailed items to be gleaned from the graphs and charts by the interested reader.[1]

---

* The author is indebted to Homer L. Hitt, who is now Dean of Louisiana State University in New Orleans, Louisiana, for guidance and counsel relative to this analysis. The original project was started by Hitt. However, the study was carried to completion by the author after administrative duties forced Hitt to curtail his research activities.

Although the analysis focuses directly upon the rural-farm population of the state in 1950, information about the rural-nonfarm and urban populations are presented through the use of the comparative approach. This should make the monograph of widespread interest to persons concerned with any or all segments of the state's people. The comparative approach emphasizes the position of the rural population in the total society and draws attention to the fundamental differences among the rural, urban and total populations.

The data which serve as a basis for this study are taken from the *1950 Census of the United States.* In some cases, statistics from previous censuses are utilized in order to establish trends. However, for the most part, this analysis is concerned with the status of the population of Louisiana at mid-century and is based upon census data for 1950.

There are several concepts used in the study which need explanation. Whenever reference is made to residence (urban, rural-nonfarm, and rural-farm), it is always in terms of the definitions adopted by the United States Census in 1950, unless otherwise specified.[2] The only instances in which the old definitions of residence are used are in connection with trend analyses. In discussing race, several terms are used: white, nonwhite, Negro, and "other races." Nonwhite usually refers to a group of people composed of Negroes and members of "other races." However, since the number of persons of "other races" in Louisiana is extremely small, the term "nonwhite" and Negro can be interpreted as being synonymous. In describing geographical variations of social phenomena within the state, rural social areas are sometimes used to identify the different localities. These rural social areas and the parishes comprising them are as follows:

---

[1] For those persons who require specific data in their work, a mimeographed compilation of basic population tables providing information by parishes is being prepared and will be available from the Department of Rural Sociology, Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana.

[2] "According to the new definition that was adopted for use in the 1950 Census, the urban population comprises all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, and villages, (b) incorporated towns of 2,500 inhabitants or more except in New England, New York, and Wisconsin, where 'towns' are simply minor civil divisions of counties, (c) the densely settled urban fringe, including both incorporated and unincorporated areas, around cities of 50,000 or more and (d) unincorporated places of 2,500 inhabitants or more outside any urban fringe . . . The farm population for 1950, as for 1940, and 1930, includes all persons living on farms without regard to occupation . . . The rural-nonfarm population includes all persons living outside urban areas who do not live on farms." United States Census, 1950, *Louisiana,* "General Characteristics," Vol. II, Part 18, pp. iv and v.

1. The Red River Delta Area—Caddo, Bossier, DeSoto, Red River, Natchitoches, and Rapides parishes.
2. The North Louisiana Uplands—Webster, Claiborne, Union, Lincoln, Bienville, and Ouachita parishes.
3. The Mississippi Delta Area—Morehouse, West Carroll, East Carroll, Franklin, Madison, Richland, Catahoula, Tensas, Concordia, Pointe Coupee, East Feliciana, and West Feliciana parishes.
4. The North Central Louisiana Cut-Over Area—Jackson, Winn, Grant, Caldwell, and LaSalle parishes.
5. The West Central Cut-Over Area—Beauregard, Sabine, and Vernon parishes.
6. The Southwest Rice Area—Cameron, Calcasieu, Allen, Jefferson Davis, Acadia, and Vermilion parishes.
7. The South Central Louisiana Mixed Farming Area—Evangeline, St. Landry, Avoyelles, and Lafayette parishes.
8. The Sugar Bowl Area—West Baton Rouge, Iberville, St. Martin, Iberia, St. Mary, Assumption, Ascension, St. James, St. John the Baptist, Lafourche, and Terrebonne parishes.
9. The Florida Parishes Area—St. Helena, East Baton Rouge, Livingston, Tangipahoa, and Washington parishes.
10. The New Orleans Truck and Fruit Area—Orleans, St. Tammany, St. Bernard, Plaquemines, Jefferson, and St. Charles parishes.

The use of these rural social areas in describing variations among the parishes facilitates undertsanding and analysis in that meaningful comparisons can be made on the basis of ten areas, whereas differentials among 64 parishes are extremely tedious and difficult to describe.[3]

NUMBER AND DISTRIBUTION

In 1950, the population of Louisiana numbered 2,683,516 persons. These people, however, are not evenly distributed throughout the state. Rather they are concentrated in certain areas while other sections of Louisiana are sparsely settled. Figure 1 portrays the distribution of the state's population. The locations and relative sizes of the various urban centers are immediately apparent. Generally, the rural concentrations of population center around urban places. In the New Orleans area, there is a concentration along the highways. Another narrow ribbon-like clustering of people borders the Mississippi River northward toward Baton Rouge. Still another concentration is found in the western portion of

---

[3] For a detailed description of these rural social areas and the manner by which they are delineated, the reader is referred to Alvin L. Bertrand, *The Many Louisianas,* Louisiana Agricultural Experiment Station Bulletin No. 496, June, 1955.

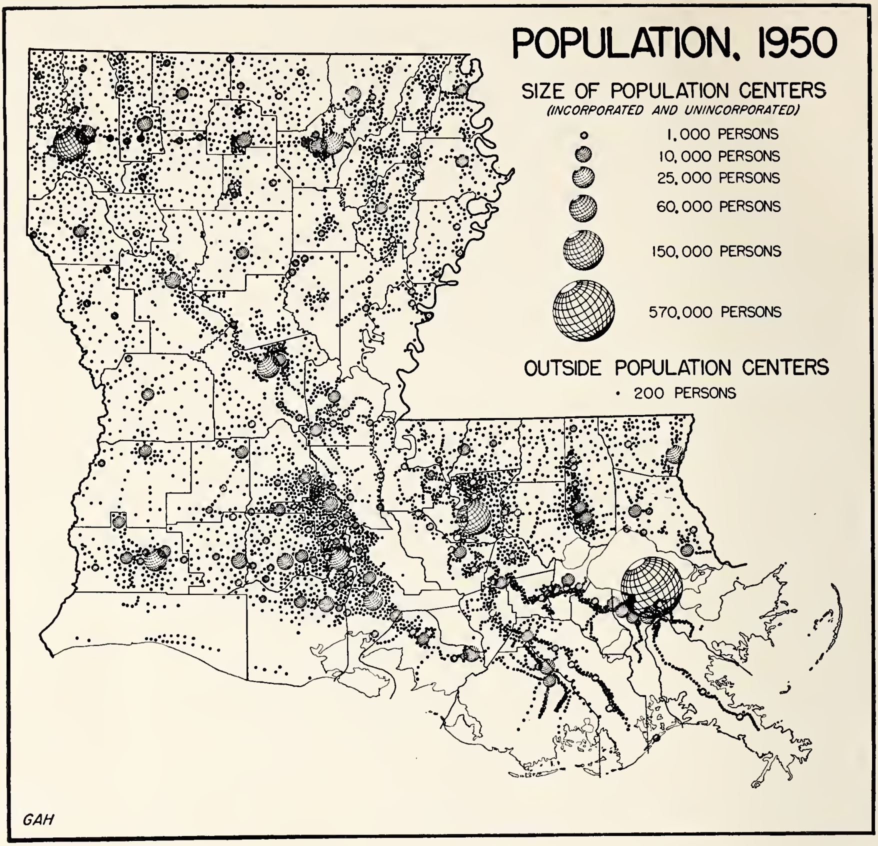


FIGURE 1.—Population Distribution, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 6.)

Tangipahoa Parish. Here a heavy rural population surrounds the towns of Kentwood, Roseland, Amite, Independence, Hammond and Ponchatoula. There is a considerable concentration of rural people in the area surrounding the city of Baton Rouge. Perhaps the largest grouping together of rural people is found in the section around the city of Lafayette and other smaller cities in that area. The lack of rural population of very high density surrounding the city of Shreveport is somewhat surprising. There is, of course, a rural concentration in the area, but it is not of the same magnitude as those surrounding Baton Rouge, Lafayette, and some of the other urban places. Rural population concentrations are also found around the cities of Alexandria and Monroe. Virtually every urban place, regardless of size, is ringed by a zone of dense rural population.

On the other hand, certain sections of the state have a paucity of inhabitants. This lack of people in these areas is generally a result of the geographical conditions of the areas concerned. In the coastal marshlands bordering the Gulf of Mexico, there are very few people. In fact, there is a wide strip of land along the southern coast of the state which is virtually unpopulated. The nature of this area practically precludes settlement. The people who do live in this area reside, for the most part, on finger-like projections of high ground along the bayous and have not penetrated far into the surrounding hinterland. There is another sizable unpopulated area located in parts of St. Landry, St. Martin, Iberville, and Iberia parishes comprising the Atchafalaya basin through which has been constructed the Morganza Spillway. Sparse populations prevail in the cut-over lands of West Central Louisiana embracing Beauregard, Vernon, and Allen parishes. In North Central Louisiana, a large area set aside as a National Forest is characterized by low population density.

These areas of low population density are very well illustrated by Figure 2, which shows the number of persons per square mile by minor civil divisions in 1950. They have, for the most part, population densities of less than 20 persons per square mile. Beauregard, Caldwell, Cameron, Catahoula, LaSalle, Vernon, and Winn parishes have population densities which fall into this classification. Several other parishes have low population densities. Among these are West Feliciana (24.8), Allen (24.3), Bienville (23.1), St. Bernard (21.7), St. Helena (21.4) , Grant (21.3) , Tensas (21.2) , Union (21.1) , Concordia (20.3), and Sabine (20.3) parishes. All of the remaining parishes have man-land ratios of above 25 persons per square mile.

On the other hand, seven parishes have high population densities. Orleans Parish, which is coterminous with the city of New Orleans, has the highest population density (2,866.6). Other parishes which are densely populated are East Baton Rouge (342.5), Jefferson (254.0), Lafayette (204.3), Caddo (196.2), and Ouachita (116.4). No other parishes had densities of 100 or more persons per square mile. As would be expected, the major urban centers of the state are located in these parishes which have high population densities.

In terms of absolute numbers, Orleans Parish had by far the largest population (570,445) in 1950. Three other parishes have populations of over 100,000. These are Caddo, East Baton Rouge, and Jefferson. Other heavily populated parishes are Rapides (90,648), Calcasieu, (89,635), St. Landry (78,476), Ouachita (74,713), Lafayette (57,743), and Tangipahoa (53,218). No other parish had as many as 50,000 persons in 1950.

In 1950, the state had only two parishes with less than 10,000 inhabitants. These were Cameron (6,244), and St. Helena (9,013). Other parishes with comparatively small populations in 1950 were Catahoula

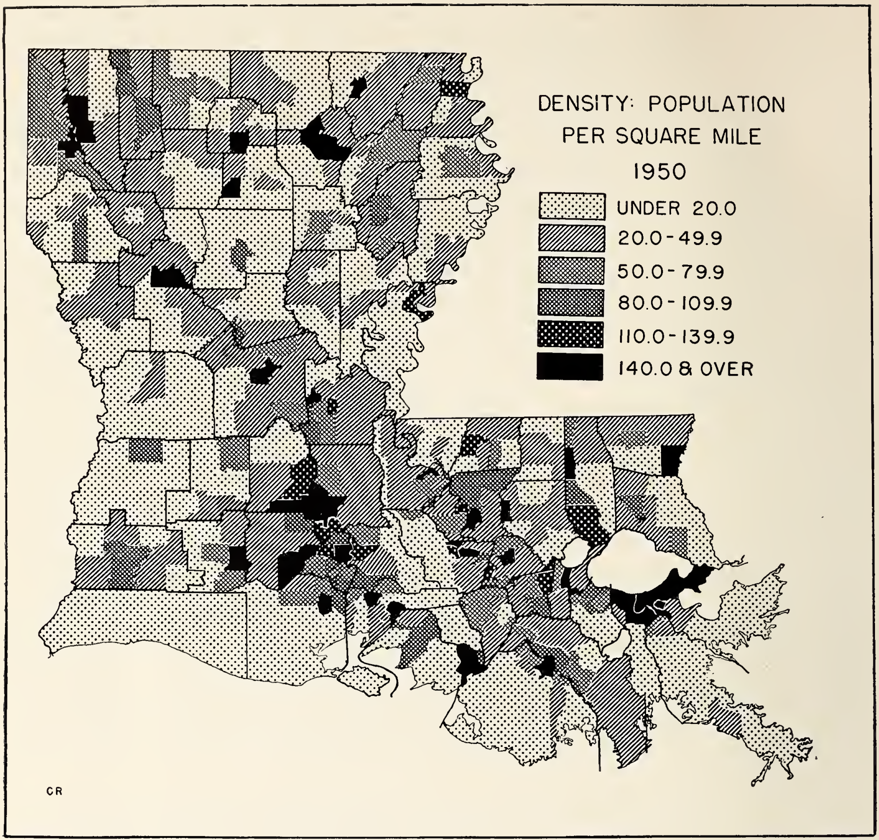


FIGURE 2.—Density: Population Per Square Mile, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 5.)

(11,834), West Baton Rouge (11,738), St. Bernard (11,087), Caldwell (10,293), and West Feliciana (10,169). All of the remaining parishes had populations of 12,000 persons or more.

RESIDENCE

For the first time in history, the majority of Louisianians lived in urban places in 1950. Specifically, 1,471,696 of the state's residents (or 54.8 per cent) were residing in cities. Of the remaining population, 644,365 persons (24.0 per cent) were classified as having rural-nonfarm residence and 567,445 (21.2 per cent) were living on farms. However, in 1950 there were still 17 parishes in which no urban center was located. Included among these parishes were Assumption, Bienville, Caldwell, Cameron, Catahoula, Grant, LaSalle, Livingston, Plaquemines, Red River, St. Helena, St. James, Tensas, Union, West Carroll, and West Feliciana. In other words, in none of these parishes was there a center with as many as 2,500 inhabitants, the official demarcation point between urban places and rural areas.

More than half of the population in ten parishes was on farms in 1950. Among parishes of this type are St. Helena (75.3 per cent), Franklin (74.8 per cent), West Carroll (72.3 per cent), Red River (67.2 per cent), Richland (64.0 per cent), Tensas (63.6 per cent), East Carroll (61.0 per cent), Catahoula (59.0 per cent), Pointe Coupee (51.5 per cent), and Livingston (50.2 per cent). These are the parishes of the state in which farm people remain in the majority.

A fact unknown to many persons is that in several of the parishes, the rural-nonfarm group constitutes the largest segment of the population. In fact, in 17 of the parishes in 1950, the majority of the people lived

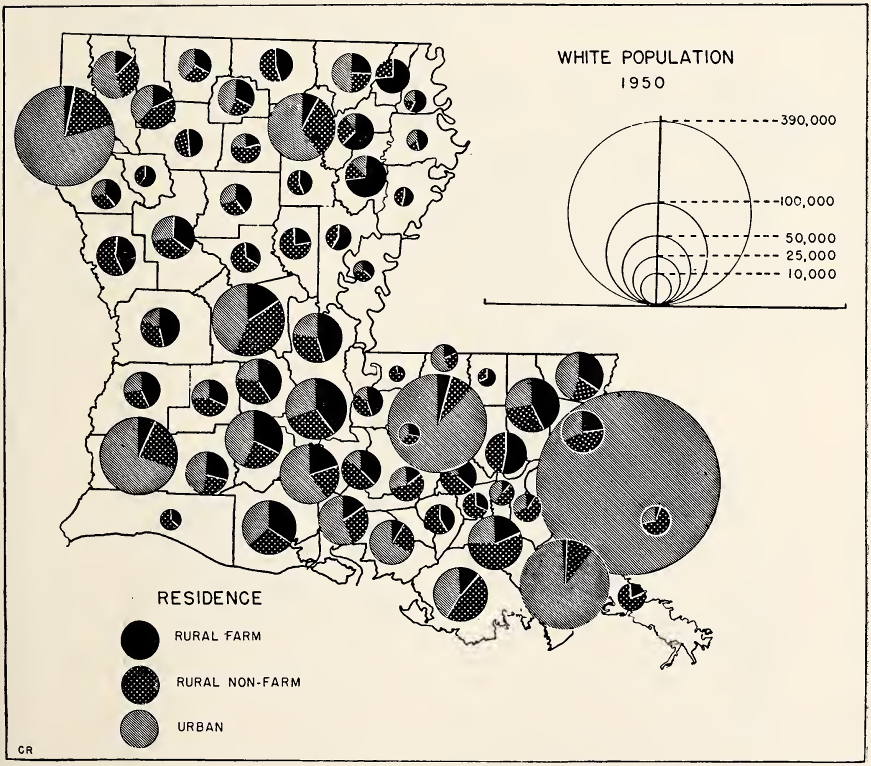


FIGURE 3.—The White Population, Louisiana, 1950, by Residence (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Tables 41, 48, 49.)

in areas which were classified as rural-nonfarm. These parishes were Plaquemines (82.4 per cent), LaSalle (78.6 per cent), St. Bernard (70.8 per cent), Iberville (66.3 per cent), St. Charles (65.2 per cent), Cameron (65.0 per cent), Grant (64.4 per cent), St. James (64.2 per cent), West Feliciana (62.2 per cent), Sabine (61.9 per cent), Jackson (58.6 per cent), Caldwell (57.3 per cent), St. John the Baptist (56.4 per cent), Assumption (56.0 per cent), Lafourche (54.7 per cent), Union (53.5 per cent), and Bienville (51.8 per cent). These parishes appear to fall into two different categories. One of these is the group in which the main occupation is a rural industry other than farming, i.e., fishing, trapping, etc. The other category includes those parishes with large suburban populations tributory to urban centers located in adjacent parishes.

The residential distributions of white and nonwhite residents of the state are generally similar. Figures 3 and 4 graphically portray the residential status of the white and nonwhite populations, respectively. In

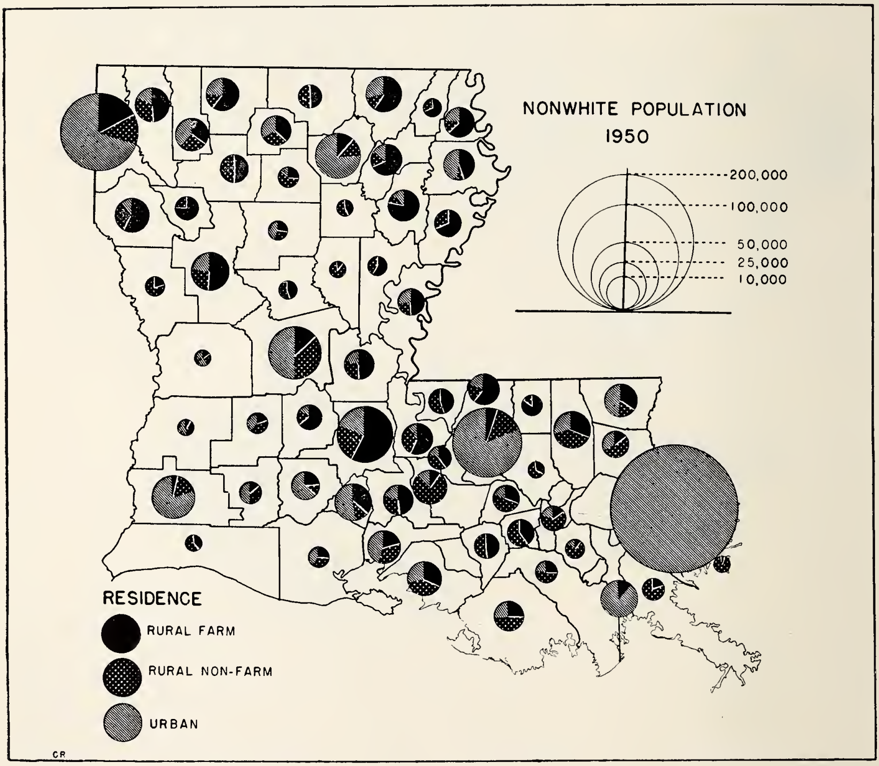


FIGURE 4.—The Nonwhite Population, Louisiana, 1950, by Residence. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Tables 44, 48a, 49a.)

1950, 18.5 per cent of the white people of the state lived on farms, 24.6 per cent resided in rural-nonfarm areas, and 56.9 per cent lived in urban places. Comparable percentages for the nonwhite population are 26.5, 22.9, and 50.6, respectively. These figures show that the nonwhites of the state are farm dwellers to a much larger extent than the whites. An examination of Figure 3 reveals that in the Mississippi Delta Area, the whites reside on farms to a greater extent than in some of the other areas. In all but four parishes in this area, more than 40.0 per cent of the whites live on farms. In the West Florida Parishes Area a similar proportion of whites reside on farms in Tangipahoa, St. Helena, and Livingston parishes. The entire West Central Cut-Over Area has a relatively large proportion of its white population classified as farm residents. A similar situation exists in Bienville and Union parishes in the North Louisiana Uplands Area. The white populations of Avoyelles, Caldwell, Evangeline, and Red River parishes, which are in scattered locations within the state, also have large proportions of their whites in the farm classification. No other parishes or areas had as much as 40.0 per cent of their white people residing on farms.

Generally, those areas in which a large portion of the whites are farm residents also have a similarly high proportion of nonwhites as farm residents. (Compare Figures 3 and 4.) There are some notable exceptions to this generalization, however. For instance, in Beauregard Parish, 42.9 per cent of the whites and only 7.8 per cent of the nonwhites are farm residents. Thus, in some parishes the white populations reside on farms to a greater extent than the nonwhites. In fact, this situation prevails in 18 parishes. The differences, however, between the proportions of whites and of nonwhites living on farms in many of these parishes are rather small.

AGE COMPOSITION

A very vital aspect of the population of any society is its age structure. Age composition is related to many conditions which prevail within a particular group. For instance, differences in levels of living between societies might possibly stem from an extremely large proportion of persons in the dependent ages in one as contrasted to another group. Also, the productive capacity of a society is dependent somewhat upon the proportion of workers in the productive ages within the group.

In 1950, the median age of the people of the state was 26.7 years. This is considerably less than the median age of the population of the United States, which was 30.2 years. This indicates that the people of Louisiana, on the average, are younger than their counterparts in the nation. Within the state, the rural-farm population had, by far, the lowest median age, being 21.6 in 1950. The rural-nonfarm people recorded the next lowest median age (24.9 years), and the urban people had the highest median age. The latter had a median age of 28.7 years in 1950. Therefore, not only does the state have a "younger" population than the nation as a whole, but the rural-farm and rural-nonfarm people within the state have considerably lower median ages than the people who live in cities. This observation reflects the basic age structure of the rural people of the state.

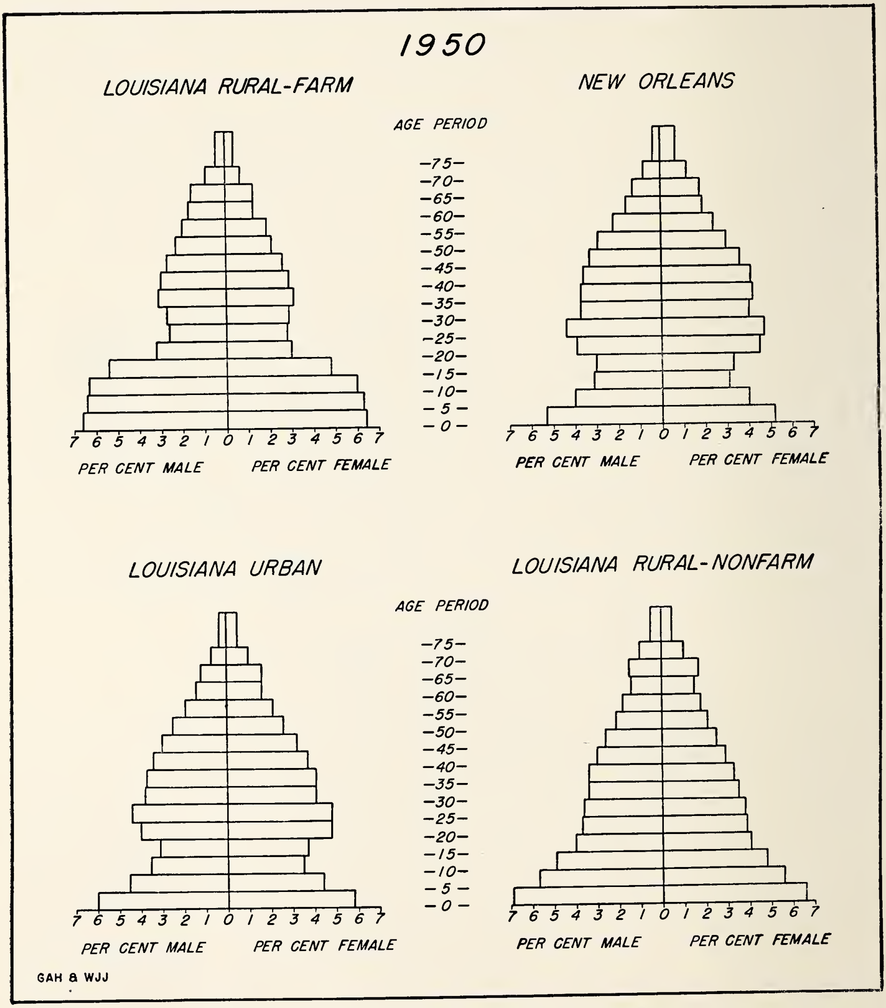


FIGURE 5.—Age-Sex Pyramids, Louisiana, 1950, by Residence. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Tables 41, 48, 49.)

The rural-farm population of the state is characterized by an excessively large proportion of children and a proportionately small number of persons in the productive years of life. Figure 5 has been prepared to demonstrate the differences in the age structures of the rural farm, the rural-nonfarm, and the urban populations in 1950. It also shows the age structure of New Orleans, which is the most urban area in the state. By comparing these age-sex pyramids, the reader can readily detect the basic differences in the age composition of the different segments of the population. In contrast to the age composition of the rural-farm population, the populations of the urban places and of New Orleans have relatively few children and a proportionately large number of people in the productive years. The population of the rural-nonfarm areas has an age structure which is somewhat different from both the rural-farm and urban peoples. The rural-nonfarm population is characterized by a large proportion of children, but it does not have the excessively small proportion of people in the productive ages as does the rural-farm population. Nevertheless, the age structure of the rural-nonfarm population more closely approximates that of the rural-farm population than that of the urban people. It does not have the proportionately large share of people in the productive years of life which is typical of urban populations.

The increase in the birth rate which began during the Second World War and has continued to the present is reflected in the age-sex pyramids of the various residential groups of the state. This change is clearly visible for the urban population and for that of New Orleans. The comparatively large proportion of children in the two age groups under ten years are results of this upturn in the birth rate. If one analyzes the age structure in 1940, he will find no such large proportions in these age groups. Furthermore, if this increased birth rate continues indefinitely, it will serve to change fundamentally the age structures of the cities and of the urban population. It will also be reflected, to a lesser extent, in the age structures of the rural-farm and rural-nonfarm populations. However, since rural peoples have long been characterized by a high birth rate, the recent increase in the general rate of reproduction probably has occurred in greater proportion in the urban areas.

In order to show more clearly the variations in the age structures of the rural-farm, rural-nonfarm, and urban populations, Figures 6, 7, and 8 have been prepared. These also show the differences in age composition by race in the three residential categories. These figures compare the age structures of the white and nonwhite populations of the urban, rural-farm, and rural-nonfarm areas to that of the state. In other words, the age structure of the state's population is used as the standard in these figures.

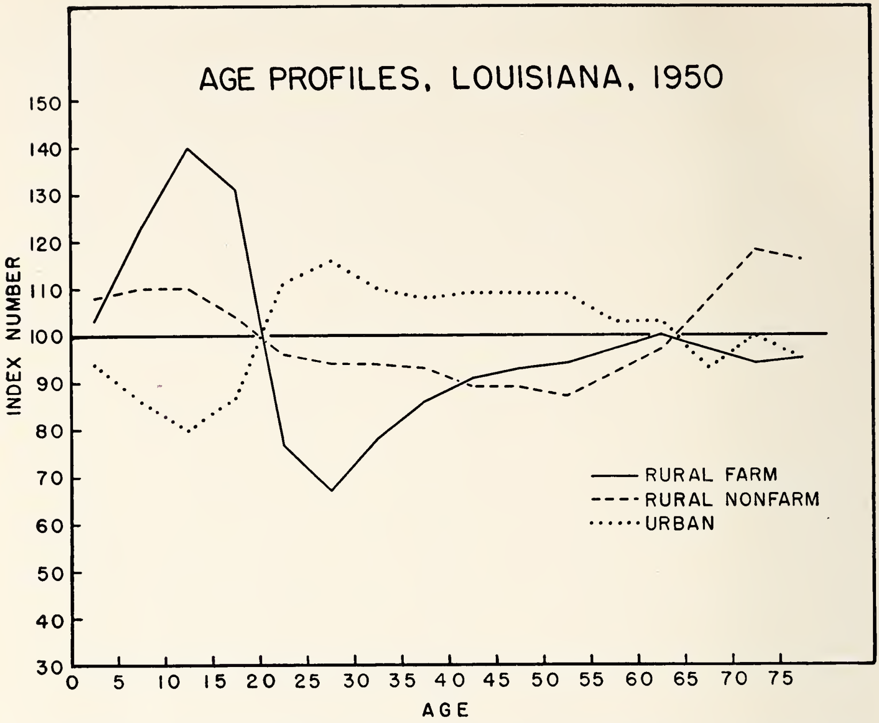


FIGURE 6.—Age Profiles, Louisiana, 1950, by Residence. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Tables 41, 48, 49.)

and is represented by the straight line extending from the index of 100. Therefore, an index of 90 for the age 5 years in the urban population means that there are 90 children aged 5 years in the urban population compared to every 100 of that age in the state's total population.

The most readily observed fact about these index-number curves is the opposite shapes of those representing the rural-farm and the urban populations. Under 20 years of age, the rural-farm population has a very high proportion of persons while the urban population has a relatively small proportion in this age category. However, between the years 20 and 60 the situation is reversed. The urban population has a very high proportion of its population in these ages and the rural-farm population has a considerable under-representation of people in these ages. Since these are the so-called productive years of life, this diffrence is of great importance. It is interesting to note that the aged persons (65 years of age and over) tend to be disproportionately concentrated in the rural-nonfarm population. Neither the rural-farm nor the urban population is character-

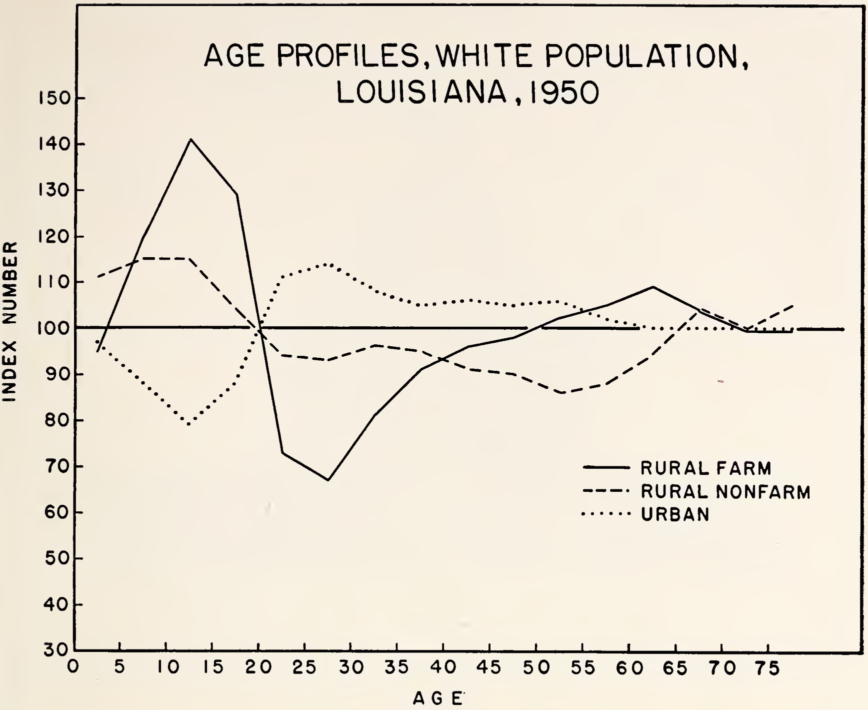


FIGURE 7.—Age Profiles, White Population, 1950, by Residence. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 15.)

ized by such a large proportion of aged persons. The age composition of the rural-nonfarm population tends to be somewhat similar to that of the rural-farm population except in regard to the aged.

Apparently the age structures of the whites and the nonwhites are not radically different in any age category except among the aged. A comparison of Figures 7 and 8 clearly indicates that the age structure is similar for whites and nonwhites. They differ most notably in the relative importance of aged persons among each racial group. Among the whites, aged persons constitute about equal proportions in the rural-farm and urban populations. The rural-nonfarm white population has a slightly greater proportion of aged persons than found among whites in the other residential categories. Among the nonwhites, on the other hand, there is a relatively small number of aged persons in the rural-farm and urban populations. The most outstanding aspect of the age structure of the nonwhite population is the tendency for aged Negroes to choose the rural-nonfarm areas as a place of residence. Figure 8 clearly demonstrates the

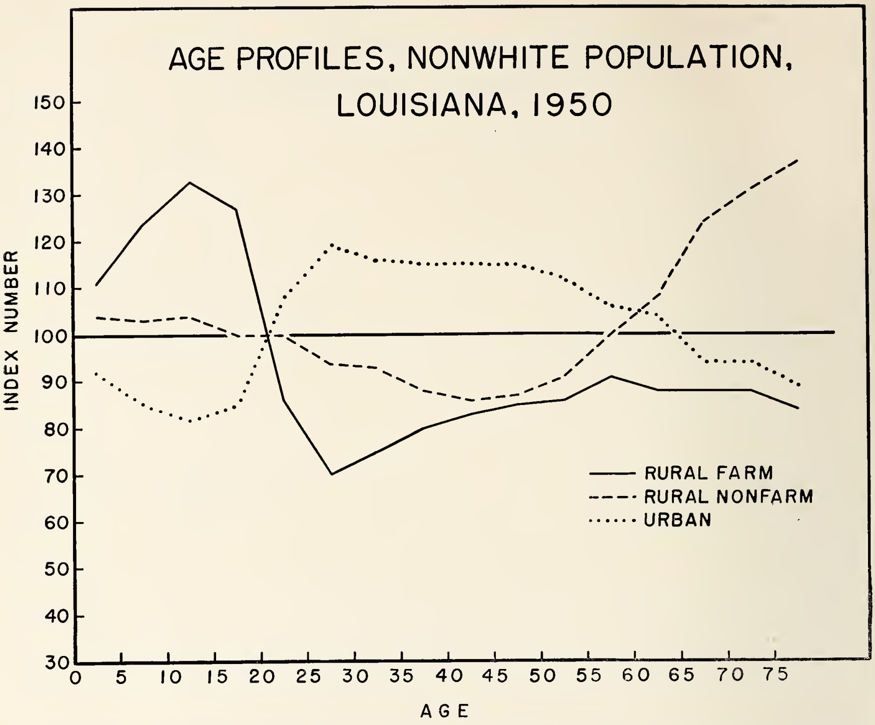
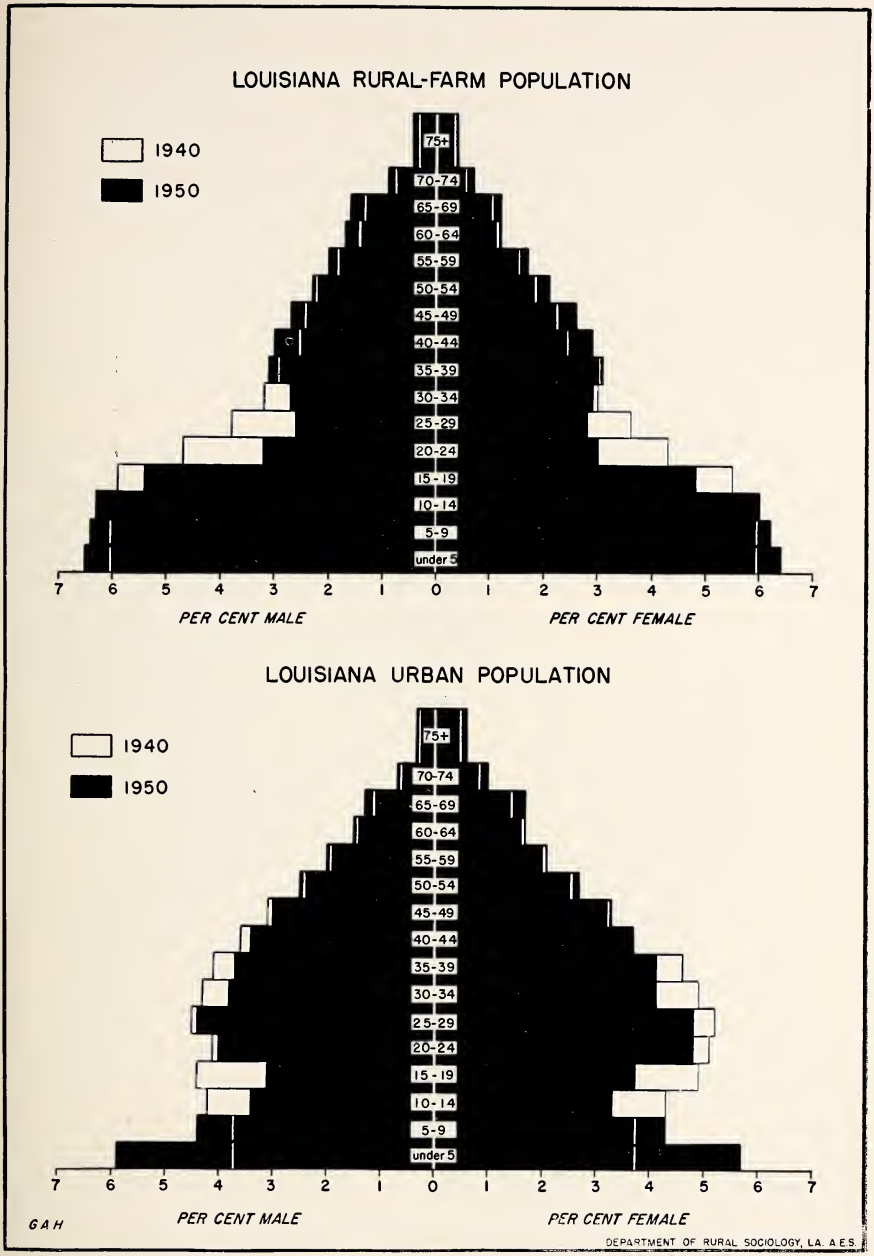


FIGURE 8.—Age Profiles, Nonwhite Population, 1950, by Residence. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 15.)

much greater concentration of aged nonwhites in the rural-nonfarm areas than in the urban and rural-farm localities.

The causative factors involved in differentiating the age structures of the urban, rural-nonfarm, and rural-farm populations deserve explanation. Essentially, three factors are responsible for the age structures which exist for each of these areas. These are the birth rates, the death rate, and migration. The effects of the differential in birth rates between urban, rural-nonfarm, and rural-farm peoples which prevailed before 1940 are clearly visible in the age structures of the different peoples. The lower birth rate of the urban people caused their age structure to be characterized by a comparatively low proportion of young children. Of course, the increase in the urban birth rate since the Second World War has materially changed this tendency. The decreasing death rate also affects the age structure. The increasing proportions of the aged in the society result, for the most part, from the decreases which have been made in mortality during the last several decades. However, the most important



LOUISIANA RURAL-FARM POPULATION

LOUISIANA URBAN POPULATION

FIGURE 9.—Age-Sex Pyramids, Urban and Rural-Farm Population, Louisiana, 1940 and 1950. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 15.)

factor differentiating the age structures of the urban, rural-nonfarm, and rural-farm populations is migration. The low proportion of persons in the productive ages in the rural-farm population and the high proportion in these ages in the urban population result from the rural-urban migration which takes individuals in these years of life from farms and adds them to the population of the cities. This movement has been underway for a long period of time. Young people move from the farms into the cities where they seek employment in the expanding industry and commerce. The high proportion of aged persons in the rural-nonfarm areas is also a result of migration. It appears that many aged persons leave both the farms and the cities to live out the remainder of their lives in the small towns and villages of the state. This seems to be especially true of nonwhites.

In order to demonstrate the changes which have occurred between 1940 and 1950 in the age structures of the rural-farm as contrasted to the urban populations, Figure 9 has been prepared. In the rural-farm population, significant decreases took place in the proportion of males in the ages 15 to 34 years. The decrease was greatest in the 20 to 24 year age group. Among females in the rural-farm population, a similar decrease took place in the relative importance of persons in ages 15 to 29 years, and a very small relative decline occurred in the number of 30 to 34 year old women. Among females, the 20 to 24 year group also underwent the largest relative decrease. In the rural-farm population, there were increases in the relative proportion of both males and females in the ages under 10 years and 35 years of age and over. These trends undoubtedly reflect the greater life expectancy of persons in 1950 as contrasted to 1940, the increase in the birth rate since the Second World War, and the pattern of rural-urban migration which takes farm youth into the cities of the state.

It is interesting to note that the urban population underwent changes in its age structure between 1940 and 1950 which followed a pattern similar to that observed for the rural-farm population. Among urban males, proportionate decreases occurred in the ages 10 to 49 years. However, some of these decreases were very small. Substantial relative declines were recorded among urban men aged 10 to 20 years and 30 to 40 years. For both urban males and females, very significant relative increases took place in the age group 10 years and younger. Likewise, notable increases were recorded in the relative importance of persons in ages above 50 years for men and above 45 years for women. The same factors listed as causative elements in the changes which have occurred in the rural-farm population also are responsible for the changes in the urban age structure.

In our society persons under 15 years of age and over 65 years of age are often considered to be in a dependent status. If the number of individuals in these dependent ages is related to the number in the ages 15 to 65, an age dependency ratio results. This is usually expressed as the number of persons in the dependent ages for each 1,000 persons in the productive years of life. In Louisiana, the age dependency ratio was 614 in 1950. The figure for the rural-farm population was considerably higher (778). Age dependency ratios for the other residential categories were 516 for the urban population and 633 for the rural-nonfarm. These data mean that each 1,000 persons in the productive ages in the farm population have a considerably greater burden to carry, insofar as dependents are concerned, than the peoples of the cities and the rural-nonfarm areas.

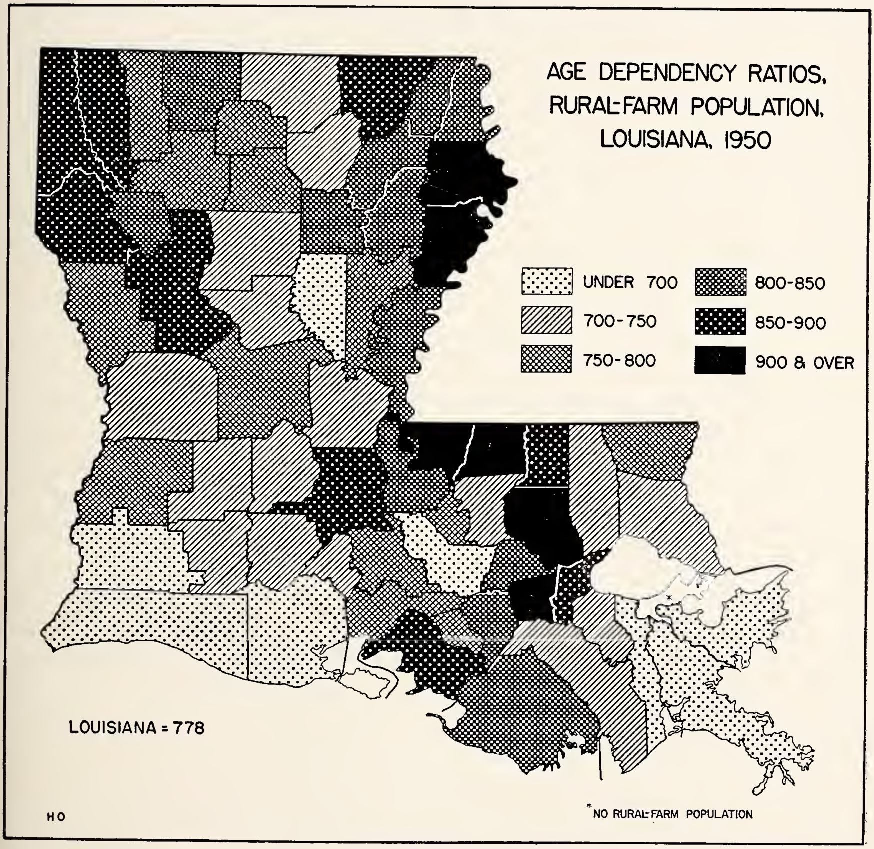

AGE DEPENDENCY RATIOS, RURAL-FARM POPULATION, LOUISIANA, 1950
UNDER 700
700-750
750-800
800-850
850-900
900 & OVER
LOUISIANA = 778
*
HO
*NO RURAL-FARM POPULATION

FIGURE 10.—Age Dependency Ratios, Rural-Farm Population, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 49.)

Insofar as the individual parishes are concerned, the age dependency ratios varied from a low of 468 in Orleans Parish to a high of 850 in St. Helena Parish. Besides Orleans Parish, ten others had age dependency ratios of 600 or less in 1950. These were Bossier, Caddo, Calcasieu, East Baton Rouge, East Feliciana, Jefferson, Lafayette, Lincoln, Ouachita, and West Feliciana. For the most part, these are the more urban parishes of the state. Undoubtedly the presence of large state institutions in East and West Feliciana parishes accounts for the low age dependency ratios prevailing in those areas. On the other hand, seven parishes besides St. Helena had age dependency ratios of 800 and over in 1950. These were Assumption, East Carroll, Pointe Coupee, Red River, St. James, Tensas, and West Carroll parishes. Generally, these are rural parishes.

To point up the variations among parishes in the age dependency ratios of the rural-farm populations, Figure 10 has been prepared. This map shows that among the farm population of eight parishes, the age dependency ratio is 700 or less. These are Calcasieu, Cameron, Iberville, Jefferson, LaSalle, Plaquemines, St. Bernard, and Vermilion parishes. On the other hand, there are 900 or more persons in the dependent ages per 1,000 individuals in the productive ages in the farm population of six parishes. Livingston, East Feliciana, West Feliciana, St. James, Tensas, and Madison parishes have farm populations characterized by these high age dependency ratios.

SEX COMPOSITION

In 1950, women were numerically dominant in the population of Louisiana. In fact, there were only 96.7 men for each 100 women in the state at that time. However, if the sex ratios of the different residential categories are studied, a very different picture is revealed. The urban population had a sex ratio of only 92; the rural-nonfarm had 100.2; and the rural-farm population had 105.6 men for every 100 women. Women are numerically dominant in the cities of the state. In the rural-nonfarm areas, the sexes are in about equal numerical balance, and the rural-farm population is dominated by men. It is interesting to note that in the urban populations of 15 parishes the sex ratios are in the 80's. Only the urban population in St. John the Baptist Parish had as many men as women.

In 21 of the parishes, there were more men than women in the rural-nonfarm populations in 1950. In West Feliciana Parish, the rural-nonfarm population had a sex ratio of 215.8. This very high ratio of men to women undoubtedly stems from the presence of the state penitentiary in that parish, which is populated by males for the most part. Also, Bossier Parish had an excessively high sex ratio, 145.8, for the rural-nonfarm population. The adjacency of the city of Shreveport and the presence of a large air base undoubtedly account for this phenomenon. In all of the remaining 43 parishes, there are more women than men in the rural-nonfarm populations. Franklin, Lincoln, and Tensas parishes had sex ratios in the 80's for the rural-nonfarm people.

Only a few of the parishes have rural-farm populations which are dominated by females from a numerical standpoint. Figure 11 has been prepared to demonstrate the variations in sex composition among the rural-farm people of the different parishes. An analysis of this figure reveals that in five parishes there were more women than men in the rural-farm populations in 1950. These are De Soto, Jefferson, Red River, Tensas, and West Baton Rouge parishes. It should be pointed out that the

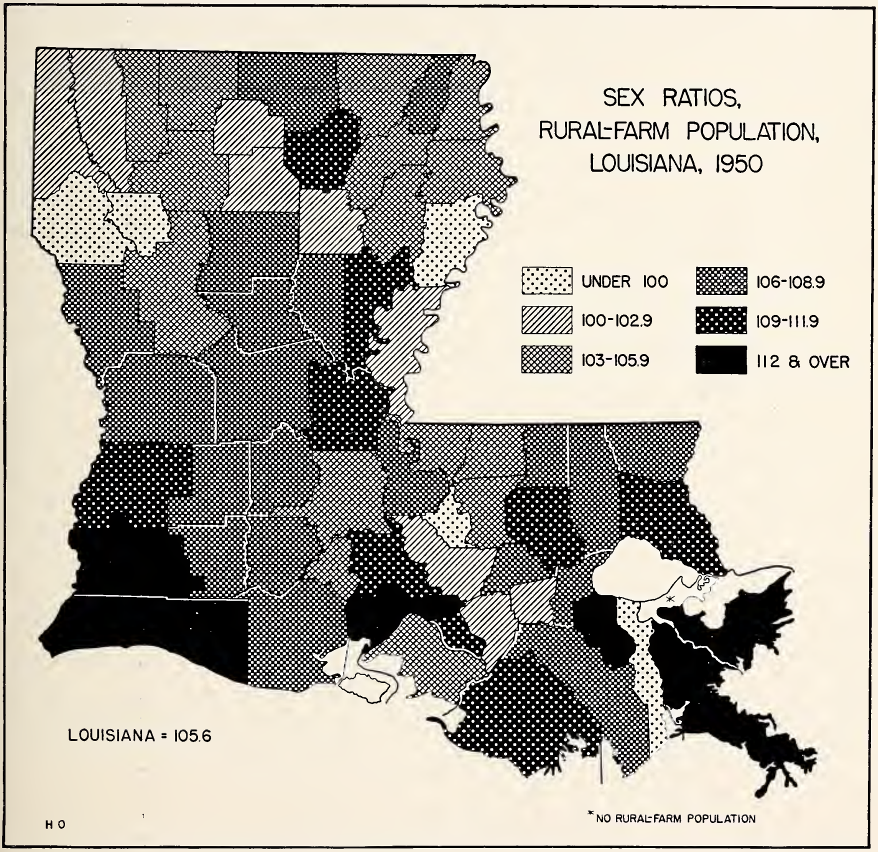


FIGURE 11.—Sex Ratios, Rural-Farm Population, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 49.)

lowest sex ratio among the rural-farm populations of these five parishes was 97.7 recorded in Jefferson. Therefore, in none of the parishes is the rural-farm population greatly dominated numerically by women. Most of the parishes have very high sex ratios among their rural-farm populations. In fact, in six of them, the sex ratios were 112 and over in 1950. Parishes with high sex ratios among farm people are Calcasieu, Cameron, Iberia, St. Charles, Plaquemines, and St. Bernard. All of these parishes are located in Southern Louisiana. Apparently there is something about farming in the coastal marshlands which has a frontier aspect to it. Such a situation is usually characterized by high sex ratios.

Louisiana therefore follows the usual pattern insofar as sex composition by residence is concerned. The cities of the state are characterized by a predominance of women in their populations. About an equal balance between the sexes characterizes the rural-nonfarm population, and the rural-farm population has a numerical dominance of males. This difference in sex composition stems from several factors. Among these are (1) the greater longevity of women as contrasted to men, (2) the sex selectivity of the rural-urban migrations which are taking place, and (3) the lower mortality rates of females at all ages. The principal factor seems to be the tendency for rural-urban migrations to be female selective. This accounts, for the most part, for the low sex ratios in cities and the high sex ratios in the rural-farm areas.

An analysis of sex composition by race shows that Negroes have lower sex ratios than whites in each of the residential categories. In the state as a whole, whites had a sex ratio of 98.6 in 1950 as compared to 92.8 for Negroes. The lowest sex ratios for both races are found in the urban population. Among whites in the cities, there were 94.2 men for each 100 women. A similar figure for Negroes was only 86.8. In the rural-nonfarm population the sex ratio for whites was 102.2 as compared to 95.7 among Negroes. The highest ratios of males to females are found in the rural-farm population. In 1950, there were 107.9 men for each 100 women among whites and 102.3 men for each 100 women among Negroes. Therefore, among both whites and Negroes the urban population is characterized by a low sex ratio, the rural-nonfarm population has an intermediate position, and the highest sex ratio is found in the rural-farm population. However, in each of these residential areas, the sex ratio of Negroes is lower than that for the white population.

RACIAL COMPOSITION

Louisiana, in 1950, had the third largest proportion of Negroes in its population among the states of the nation. Only Mississippi and South

Carolina had proportionately more Negroes than did Louisiana. At mid-century, about one-third (32.9 per cent) of the population of Louisiana was Negro. In Mississippi, 45.5 per cent of the people were classified as Negro. A similar figure for South Carolina in 1950 was 38.9 per cent. In absolute numbers, Louisiana ranked sixth among the states in the size of its Negro population. Only North Carolina, Georgia, Mississippi, Alabama, and New York had more Negroes in their populations than did Louisiana. Negroes in the population of Louisiana in 1950 totaled 882,428 persons.

An analysis of the distribution of Negroes within the state clearly shows that they are heavily concentrated in certain areas and are relatively few in others. The data indicate that in seven of the parishes, Negroes constituted 55 per cent or more of the total populations. (See Figure 12.)

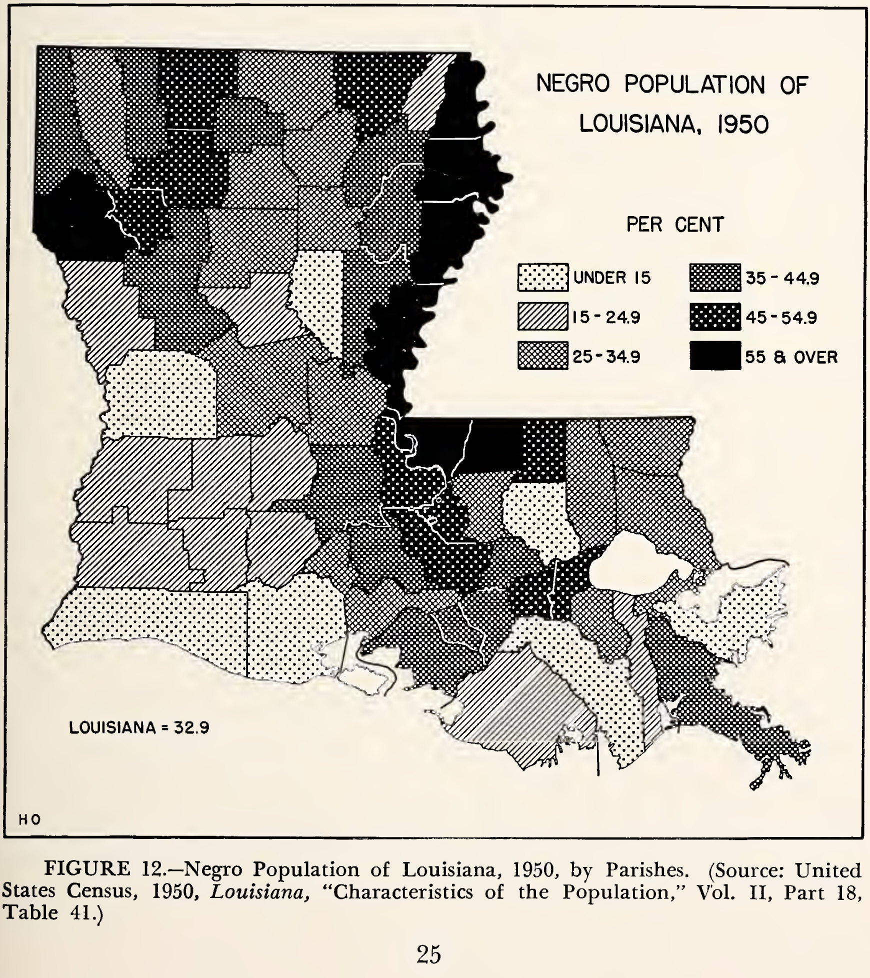


FIGURE 12.—Negro Population of Louisiana, 1950, by Parishes. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 41.)

These are DeSoto (56.6 per cent), East Feliciana (58.2 percent), Concordia (59.2 per cent), East Carroll (60.9 per cent), Tensas (64.8 per cent), Madison (66.1 per cent), and West Feliciana (71.2 per cent) parishes. In nine other parishes, Negroes made up 45 to 55 per cent of the total populations. For the most part, these parishes with very large Negro populations are located in the Mississippi River Delta Area and the Red River Delta Area. These are the areas which have long been characterized by a plantation type of agriculture.

In absolute numbers, Orleans Parish has the largest Negro population. Negroes in that parish numbered 181,775 in 1950. The second largest Negro population is found in Caddo Parish, which had 66,361 persons of that racial classification. East Baton Rouge Parish had the third largest number of Negroes (52,262). These, of course, are the parishes in which the largest cities of the state are located. Other parishes with large numbers of Negroes in their populations are Calcasieu (20,563), Ouachita (24,657), Rapides (29,967), and St. Landry (35,009).

In contrast to those parishes with large Negro populations, seven parishes had less than 15 per cent of their peoples classified as Negro in 1950. This situation prevailed in Cameron (9.3 per cent), LaSalle (10.8 per cent), Vernon (11.7 per cent), Lafourche (12.4 per cent), Vermilion (12.7 per cent), St. Bernard (14.6 per cent), and Livingston (14.7 per cent). Most of these parishes are located in the southern section of the state and a significant number of them border on the Gulf of Mexico.

In 1950, Negroes made up 30.4 per cent of the urban population of the state and numbered 447,413 persons. In only three parishes is more than half of the urban population composed of Negroes. These are Concordia, East Carroll, and Madison parishes. In Concordia Parish, Negroes constituted 60.3 per cent of the urban population in 1950. Similar figures for East Carroll and Madison parishes were 57.7 and 72.2 per cent, respectively. In each of these parishes, the total urban population is relatively small. In absolute number, Orleans Parish, all of which is considered to be urban, had the most Negroes, 181,775 persons. The urban population of Caddo Parish had 46,219 Negroes, which was the second largest group, and the cities of East Baton Rouge Parish had 42,589 Negroes to rank third. These parishes, of course, contain the three metropolitan areas of the state, New Orleans, Shreveport, and Baton Rouge.

Insofar as the racial composition of the rural-nonfarm population is concerned, the data show that 31.1 per cent were classified as Negro in 1950 (200,591 persons). In nine parishes Negroes made up more than half of the people living in the open country but not on farms. This situation obtained in St. Mary (50.3 per cent), East Feliciana (52.8 per cent, De Soto (53.3 per cent), Tensas (55.5 per cent), West Baton Rouge (56.3 per cent), St. John the Baptist (56.3 per cent), Iberville (57.5 per cent), East Carroll (59.1 per cent), and West Feliciana (63.5 per cent) parishes. In terms of absolute numbers, Rapides Parish had the most Negroes in the rural-nonfarm population. They totaled 11,007 in that parish in 1950. The rural-nonfarm population of Iberville Parish had 10,195 Negroes to rank second. No other parish had as many as 10,000 Negroes in the rural-nonfarm population. Caddo, East Baton Rouge, St. Landry, St. Mary, and Tangipahoa parishes each had more than 5,000 Negroes in their rural-nonfarm populations.

An analysis of the racial composition of the rural-farm population of the state shows that 41.3 per cent of the farm people (234,374 individuals) were classified as Negro in 1950. However, the data clearly show that a great diversity exists in the racial composition of the farm people

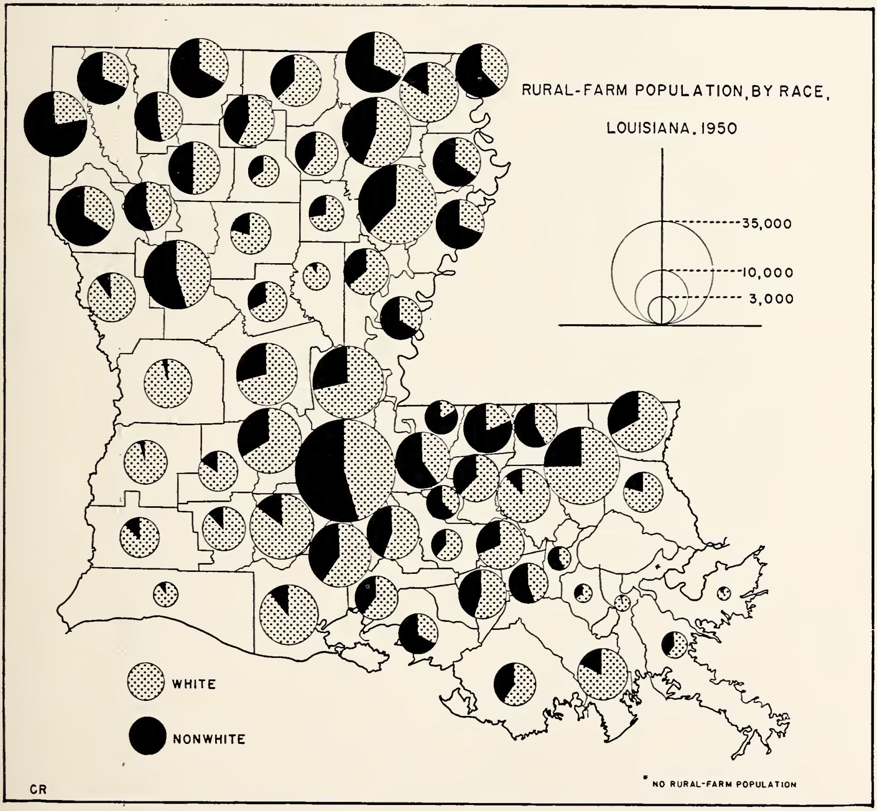

RURAL-FARM POPULATION, BY RACE, LOUISIANA, 1950
35,000
10,000
3,000
WHITE
NONWHITE
CR
* NO RURAL-FARM POPULATION

FIGURE 13.—Rural-Farm Population, by Race, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 49.)

of the various parishes. In order to demonstrate this diversity, Figure 13 has been prepared which shows the rural-farm population by race in 1950. This diagram clearly shows that Negroes are most numerous in the rural-farm population in the Red River Delta Area and the Mississippi River Delta Area. Negroes are also of considerable importance in the Florida Parishes Area, the North Louisiana Uplands, the South Central Louisiana Mixed Farming Area, and the Sugar Bowl Area. The smallest proportion of Negroes in the rural-farm population are found in the West Central Cut-Over Area and the Southwest Rice Area. They are also relatively unimportant in the New Orleans Truck and Fruit Area.

In 22 parishes Negroes constitute more than one-half of the rural-farm people. These are Bienville, Bossier, Caddo, Claiborne, Concordia, De Soto, East Carroll, East Feliciana, Madison, Morehouse, Natchitoches, Pointe Coupee, Red River, St. Helena, St. James, St. John the Baptist, St. Landry, St. Mary, Tensas, Webster, West Baton Rouge, and West Feliciana parishes. The highest proportion of Negroes in the rural-farm population is found in West Feliciana Parish. In 1950, 83.8 per cent of the rural-farm people of this parish were classified as Negro. The neighboring parish of East Feliciana had a similar high proportion of Negroes in its rural-farm population (81.4 per cent).

In several of the parishes, Negroes constituted less than one out of ten of the rural-farm population. Parishes in which this circumstance prevailed are Beauregard, Jefferson, LaSalle, Livingston, Vermilion, and Vernon. Negroes are least important in the rural-farm population of Vernon Parish, in which only 3.5 per cent was so classified in 1950. An almost equally low percentage of Negroes was found in the rural-farm population of Beauregard Parish (3.6 per cent).

Undoubtedly migratory patterns during the last two decades have brought about considerable change in the distribution of Negroes in the population of the state. However, an analysis of their distribution in 1950 compared to 1930 shows that they were still concentrated in essentially the same areas in 1950 that they were in 1930. This pattern of distribution was determined by the plantation type of agriculture which utilized slave labor before the Civil War and which is still prominent in the areas with high Negro densities.

In order to complete this analysis by race, something should be said about the distribution of persons belonging to "other races." These people make up only a very small portion (0.2 per cent) of the total population of the state. They constitute similarly small proportions of the populations of the different residential categories. In the urban population, persons of "other races" accounted for only 0.1 per cent. They make up

0.4 per cent of the rural-nonfarm and 0.1 per cent of the rural-farm population. Persons classified as "other races" are most important in Allen, Lafourche, and Terrebonne parishes. In Terrebonne, this group of people accounted for 4.3 per cent of the total population and numbered 1,856 in 1950. In the other two parishes they constituted 1.0 per cent of the total populations. The bulk of these persons are found in the rural-nonfarm populations of the above named parishes.

A review of trends in the composition of the population by race since 1900 clearly shows that Negroes are declining in relative importance. (See Table I.) In 1900, Negroes constituted 47.1 per cent of the people of the state as compared to only 32.9 per cent in 1950. Conversely, the relative proportion of whites has increased from 52.8 per cent in 1900 to 67.0 per cent at mid-century. There has been little or no change in the relative proportion of "other races" since 1900.

This decrease in the relative importance of Negroes has characterized each of the residential categories. In the urban population, Negroes accounted for 32.4 per cent in 1910 as compared to 30.4 per cent in 1950. Among the rural-nonfarm population, Negroes made up 38.5 per cent in

TABLE I.—Population of Louisiana, By Race and Residence, 1900-1950

Year	Total		White		Negro		Other	
	Number	Per Cent of Population	Number	Per Cent of Population	Number	Per Cent of Population	Number	Per Cent of Population
				Total Population				
1950	2,683,516	100.0	1,796,683	67.0	882,428	32.9	4,405	0.1
1940	2,363,880	100.0	1,511,739	64.0	849,303	35.9	2,838	0.1
1930	2,101,593	100.0	1,322,712	62.9	776,326	36.9	2,555	0.1
1920	1,798,509	100.0	1,096,611	61.0	700,257	38.9	1,641	0.1
1910	1,656,388	100.0	941,086	56.8	713,874	43.1	1,428	0.1
1900	1,381,625	100.0	729,612	52.8	650,804	47.1	1,209	0.1
				Urban Population				
1950*	1,471,696	100.0	1,022,931	69.5	447,463	30.4	1,302	0.1
1940	980,439	100.0	665,464	67.9	314,095	32.0	880	0.1
1930	833,532	100.0	575,244	69.0	257,463	30.9	825	0.1
1920	628,163	100.0	437,221	69.6	190,413	30.3	529	0.1
1910	496,516	100.0	335,175	67.5	160,845	32.4	496	0.1
				Rural-Nonfarm Population				
1950*	644,365	100.0	441,144	68.5	200,591	31.1	2,630	0.4
1940	533,059	100.0	376,829	70.7	154,678	29.0	1,552	0.3
1930	441,179	100.0	293,700	66.6	146,367	33.1	1,112	0.3
1920	385,891	100.0	236,484	61.3	148,543	38.5	864	0.2
				Rural-Farm Population				
1950*	567,455	100.0	332,608	58.6	234,374	41.3	473	0.1
1940	850,382	100.0	469,446	55.2	380,530	44.7	406	0.1
1930	826,882	100.0	453,768	54.9	372,496	45.0	618	0.1
1920	784,455	100.0	422,906	53.9	361,301	46.1	248	—

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 14, and United States Census, 1940, Vol. II, Part 3, Table 5.

* New Census definition of residence.

1920 and 31.1 per cent in 1950. Similar figures for the rural-farm population are 46.1 per cent and 41.3 per cent, respectively. The long-time trend, therefore, is in the direction of a declining relative importance of the Negro population. It is likely that this trend will continue in the immediate future, with further decreases in the relative number of Negroes.

It should be emphasized at this point that even though the last fifty years have brought about a significant *relative* decline in the Negro population, an *absolute* increase in number has taken place during this period. This means that the Negro population is growing in numbers, but it is not growing with the same rapidity as the white population. In 1900, Negroes in the state numbered 650,804 persons. This figure had increased to 882,428 persons by mid-century. Absolute increases of Negroes also took place in the urban and rural-nonfarm populations. However, an absolute *decline* in numbers occurred in the rural-farm population. This decline characterized the white rural-farm population also.

NATIVITY

In Louisiana at mid-century, the great majority of the people were classified as native-born individuals. At that time, 66.0 per cent of the population were classed as whites, 32.9 per cent as Negro, and 0.1 per cent as "other races." The Negroes, of course, are virtually all native-born since no significant immigration of these people has occurred since the days of slavery. The white population is classified by the Census into two groups: native whites and foreign-born whites. In 1950 there were 1,767,799 native whites in the state who constituted 98.4 per cent of the white population. The foreign-born numbered only 28,884 and accounted for 1.6 per cent of the white population. An analysis of the nativity of the white population of the state in 1950, by parishes, is presented in Table II. In most of the parishes, the foreign-born constitute less than one per cent of the white population. The largest proportion of foreign-born whites is found in Orleans Parish, in which they make up 3.7 per cent. Other parishes with comparatively large foreign-born populations are Tangipahoa (2.8 per cent), East Feliciana (2.3 per cent), Plaquemines (2.2 per cent), and St. Bernard (2.1 per cent). In no other parish were as many as 2 per cent of the whites classified as foreign-born persons.

From an absolute standpoint, the largest number of foreign-born whites are found in Orleans Parish. In 1950, persons in this category numbered 14,306. Caddo Parish had the next largest number of foreign-born white persons (1,836). Other parishes with comparatively large numbers of foreign-born whites were East Baton Rouge (1,564 persons), Jefferson (1,707 persons), and Tangipahoa (1,031 persons). St. Helena

TABLE II.—White Population of the Parishes of Louisiana, By Nativity, 1950

Parish	Native White		Foreign-Born White	
	Number	Per Cent	Number	Per Cent
Acadia	37,809	99.4	244	.6
Allen	14,197	99.4	85	.6
Ascension	14,328	99.0	140	1.0
Assumption	9,982	99.3	69	.7
Avoyelles	27,957	99.5	141	.5
Beauregard	14,599	99.1	140	.9
Bienville	9,668	99.1	28	.3
Bossier	25,820	98.4	408	1.6
Caddo	108,255	98.3	1,836	1.7
Calcasieu	68,432	99.1	620	.9
Caldwell	7,313	99.4	44	.6
Cameron	5,639	99.6	22	.4
Catahoula	7,673	99.8	13	.2
Claiborne	12,057	99.6	49	.4
Concordia	5,829	99.4	38	.6
De Soto	10,522	99.4	60	.6
East Baton Rouge	104,331	98.5	1,564	1.5
East Carroll	6,279	99.1	56	.9
East Feliciana	7,809	97.7	185	2.3
Evangeline	24,012	99.7	61	.3
Franklin	18,531	99.6	70	.4
Grant	10,763	99.6	43	.4
Iberia	26,849	99.1	237	.9
Iberville	13,400	98.1	262	1.9
Jackson	10,812	99.7	29	.3
Jefferson	85,897	98.1	1,707	1.9
Jefferson Davis	20,486	99.4	123	.6
Lafayette	41,639	99.1	372	.9
Lafourche	36,367	99.6	164	.4
La Salle	11,274	99.8	18	.2
Lincoln	15,345	99.5	71	.5
Livingston	16,912	98.9	186	1.1
Madison	5,843	99.2	48	.8
Morehouse	16,529	99.6	70	.4
Natchitoches	20,873	99.2	161	.8
Orleans	373,508	96.3	14,306	3.7
Ouachita	49,458	98.8	585	1.2
Plaquemines	8,541	97.8	190	2.2
Pointe Coupee	10,012	99.0	102	1.0
Rapides	59,749	98.7	803	1.3
Red River	6,046	99.8	11	.2
Richland	15,692	99.7	48	.3
Sabine	16,517	99.6	64	.4
St. Bernard	9,261	97.9	203	2.1
St. Charles	8,899	98.9	103	1.1
St. Helena	4,224	99.9	4	.1
St. James	7,522	98.6	104	1.4
St. John the Baptist	7,376	99.1	69	.9
St. Landry	43,200	99.4	258	.6
St. Martin	16,558	99.7	52	.3

(Continued)

TABLE II.—White Population of the Parishes of Louisiana, By Nativity, 1950 (Cont'd)

Parish	Native White		Foreign-Born White	
	Number	Per Cent	Number	Per Cent
St. Mary	21,785	98.6	317	1.4
St. Tammany	18,711	98.2	349	1.8
Tangipahoa	35,588	97.2	1,031	2.8
Tensas	4,586	98.8	58	1.2
Terrebonne	32,476	99.4	182	.6
Union	12,491	99.8	26	.2
Vermilion	32,098	99.6	129	.4
Vernon	16,688	99.6	68	.4
Washington	26,119	99.3	184	.7
Webster	22,582	99.6	100	.4
West Baton Rouge	5,431	98.8	66	1.2
West Carroll	14,080	99.7	47	.3
West Feliciana	2,884	98.5	45	1.5
Winn	11,686	99.9	16	.1
Louisiana	1,767,799	98.4	28,884	1.6

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 42.

Parish had the smallest number of foreign-born persons. Only 4 residents of this parish were in that classification.

A study of the foreign-born population of the state in 1950 by residence and by country of birth shows that of the 28,884 foreign-born persons, the great majority were located in the urban places. In fact, in 1950, 80.8 per cent of them were located in the cities of the state. Of the remainder, 11.4 per cent were living in rural-nonfarm areas and 7.8 per cent were in the rural-farm population. The foreign-born whites, therefore, tend to concentrate in the urban places. The rural-farm areas appear to be least attractive to foreign-born persons since only a relatively small number have chosen to settle in those localities. This is further demonstrated by the fact that 1.6 per cent of the urban population is classed as foreign-born as compared to only 0.5 per cent of the rural-nonfarm and 0.4 per cent of the rural-farm population.

Italy has contributed the largest number of persons to the population of Louisiana. (See Table III.) In 1950, 26.6 per cent of the foreign-born whites were Italians. They numbered 7,678 individuals. Of these Italians, 6,191 resided in the cities of the state in 1950 and constituted about one-fourth (26.5 per cent) of the foreign-born persons in the urban population. Of the remaining persons who were born in Italy, 731 were residents of rural-nonfarm areas and 756 were in the rural-farm population. Italians made up 22.1 per cent of the foreign-born persons in the rural-nonfarm and 33.6 per cent of those in the rural-farm population. Thus, one out of every three foreign-born persons in the rural-farm population is an

TABLE III.—Country of Birth of the Foreign-Born Population, Louisiana, 1950, by Residence

Country of Birth	TOTAL		URBAN		RURAL-NONFARM		RURAL-FARM	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
All Countries	*28,884*	*100.0*	*23,334*	*100.0*	*3,301*	*100.0*	*2,249*	*100.0*
England and Wales	1,782	6.2	1,442	6.2	236	7.1	104	4.6
Scotland	418	1.4	331	1.4	59	1.8	28	1.3
Northern Ireland	16	. .	12	.1	1	. .	3	.2
Ireland (Eire)	709	2.5	630	2.7	65	2.0	14	.6
Norway	376	1.3	345	1.5	21	.6	10	.4
Sweden	247	0.9	191	.8	35	1.1	21	.9
Denmark	213	0.7	177	.7	25	.8	11	.5
Netherlands	263	0.9	208	.9	45	1.4	10	.4
Belgium	265	0.3	164	.7	64	1.9	37	1.7
Switzerland	136	0.5	113	.5	15	.5	8	.4
France	1,521	5.3	1,294	5.5	157	4.8	70	3.1
Germany	2,467	8.5	1,932	8.3	319	9.7	216	9.6
Poland	955	3.3	636	2.7	154	4.7	165	7.3
Czechoslovakia	234	0.8	107	.4	44	1.3	83	3.7
Austria	429	1.5	367	1.6	37	1.1	25	1.1
Hungary	312	1.1	135	.6	58	1.8	119	5.3
Yugoslavia	427	1.5	256	1.1	102	3.1	69	3.1
U. S. S. R.	1,018	3.5	923	4.0	56	1.7	39	1.7
Lithuania	79	0.3	61	.3	5	.1	13	.6
Finland	92	0.3	76	.3	11	.3	5	.2
Rumania	116	0.4	103	.4	10	.3	3	.2
Greece	497	1.7	474	2.0	18	.5	5	.2
Italy	7,678	26.6	6,191	26.5	731	22.1	756	33.6
Spain	388	1.3	345	1.5	34	1.0	9	.4
Portugal	47	0.2	26	.1	13	.4	8	.4
Other European	232	0.8	170	.7	38	1.2	24	1.1
Asia	1,125	3.9	954	4.1	139	4.2	32	1.4
Canada-French	173	0.6	130	.6	39	1.2	4	.2
Canada-Other	1,029	3.6	862	3.7	140	4.2	27	1.2
Mexico	1,106	3.8	870	3.7	133	4.0	103	4.6
Other American	3,055	10.6	2,911	12.5	113	3.4	31	1.4
All Other	284	1.0	231	1.0	42	1.3	11	.5
Not Reported	1,195	4.1	667	2.9	342	10.4	186	8.3

Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 24.

Italian. About one out of every four persons in the states' foreign-born population is an Italian.

In the population of Louisiana in 1950, Germans were the second most numerous foreign-born group. There were 2,467 persons in the population at that time who had been born in Germany. These people made up 8.5 per cent of the foreign-born population. Germans also ranked as the second most important foreign-born group in the urban rural-nonfarm, and rural-farm populations. The third most numerous foreign-born group is from England and Wales. In the population of the state in 1950, persons born in these areas totaled 1,782 individuals. They made up 6.2 per cent of the foreign-born population of the state. The group born in England and Wales ranked third numerically in the urban and rural-nonfarm population. However, in the rural-farm population persons born in Hungary held third position in numbers of foreign-born. The persons born in England and Wales were the fourth most important group numerically among the foreign-born persons in the rural-farm population. Persons born in Mexico shared the fourth position with those from England and Wales.

It should be pointed out that 10.6 per cent of the foreign-born people in the state in 1950 were listed as born in "other American" countries. This group numbered 3,055 persons and exceeded the number of persons born in Germany. However, it is a composite group including persons born in all of the Latin American countries except Mexico.

Other interesting items of information about the nativity of the state's population at mid-century can be obtained from studying the data from the Census relative to state of birth[4]. In 1950, Louisiana had a population of 2,677,370 persons, of whom 83.3 per cent had been born in the state, 14.5 per cent had been born in other states, 1.1 per cent had been born in foreign countries, and the remaining 0.6 per cent included persons born in territories, possessions, etc.; born abroad of American parents; and for whom state of birth was not reported. These data further show that of the 1,751,445 native white persons living in Louisiana, 323,685 or 18.5 per cent had been born in another state. Also 7.2 per cent (63,565 persons) of the 878,790 nonwhites in Louisiana had been born in another state.

The data on state of birth show that since 1910 the relative significance of persons born in other states in the population of Louisiana has increased considerably. In 1910, this group made up 11.5 per cent of the population as compared to 12.4 per cent in 1920, 12.8 per cent in 1930, 12.7 per cent in 1940, and 14.5 per cent in 1950.

---

[4] United States Census of Population, 1950, *State of Birth,* Vol. IV, Part 4, Chapter A, Table 9.

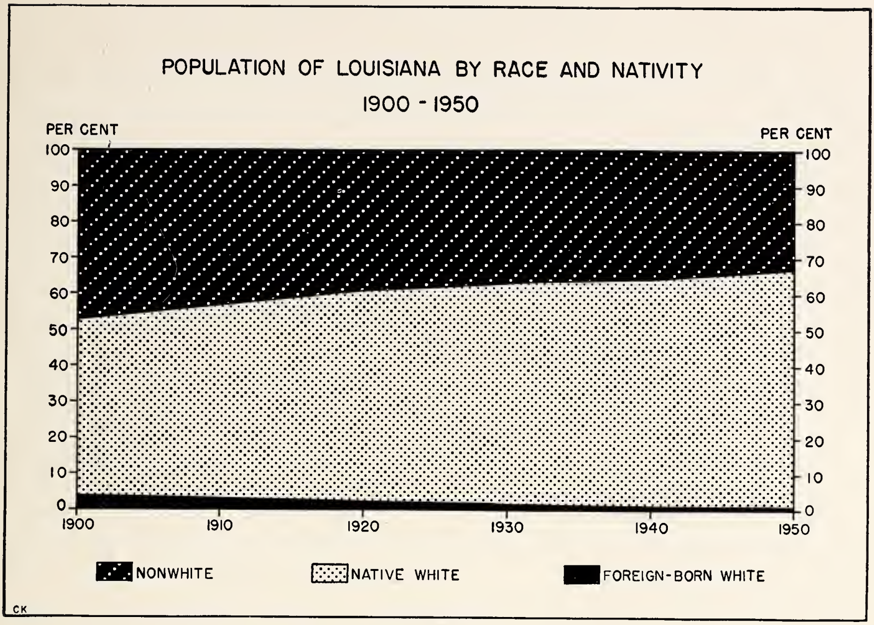


FIGURE 14.—Population of Louisiana, by Race and Nativity, 1900 to 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 14.)

In order to demonstrate trends which are taking place in the nativity of the population of the state, Figure 14, which illustrates changes since 1900, has been prepared. Generally three basic changes have occurred. (1) There has been a substantial decrease in the proportion of nonwhites. (2) A considerable increase has occurred in the proportion of the population classified as native white. (3) There has been a consistent and steady decline in the relative significance of foreign-born persons. In 1900, nonwhites made up 47.1 per cent of the population of the state as compared to 33.0 per cent in 1950. The proportion of foreign-born persons declined from 3.8 per cent in 1900 to 1.1 per cent in 1950. On the other hand, the native white population made up only 49.1 per cent in 1900 as compared to 65.9 per cent in 1950. These figures clearly demonstrate that the population of the state is now almost totally an American-grown product, and that the native whites have gained substantially in relative significance during the last half century. Undoubtedly, the decrease of the relative importance of the nonwhites has come about essentially through the migration of Negroes from the state.

EDUCATIONAL STATUS

At mid-century, the educational attainment of the people 25 years of age and over in Louisiana was still below the national average. Among whites, the median years of schooling completed was 8.8 as compared to 9.7 for the nation. (See Figure 15.) The nation's whites also had a higher educational attainment than those of Louisiana in each of the residential categories. The differential in educational attainment between whites in the state and nation was least among the urban people. In Louisiana, city dwellers had a median years of school completed of 10.2 as compared to 10.5 in the nation. Therefore, urban white people in Louisiana are nearly as well educated as whites in the nation generally. The educational differential was greater among rural-nonfarm whites. In the state, whites in the rural-nonfarm areas had a median years of schooling of 7.8, and those in a similar classification in the nation had 8.9 years. The greatest differential in educational attainment is found between rural-farm white adults in Louisiana and the nation. In Louisiana, the median years of schooling completed for this group was only 7.0 as compared to 8.6 for the United States.

A further study of Figure 15 clearly shows that nonwhites in Louisiana have a lower educational attainment than nonwhites in the nation

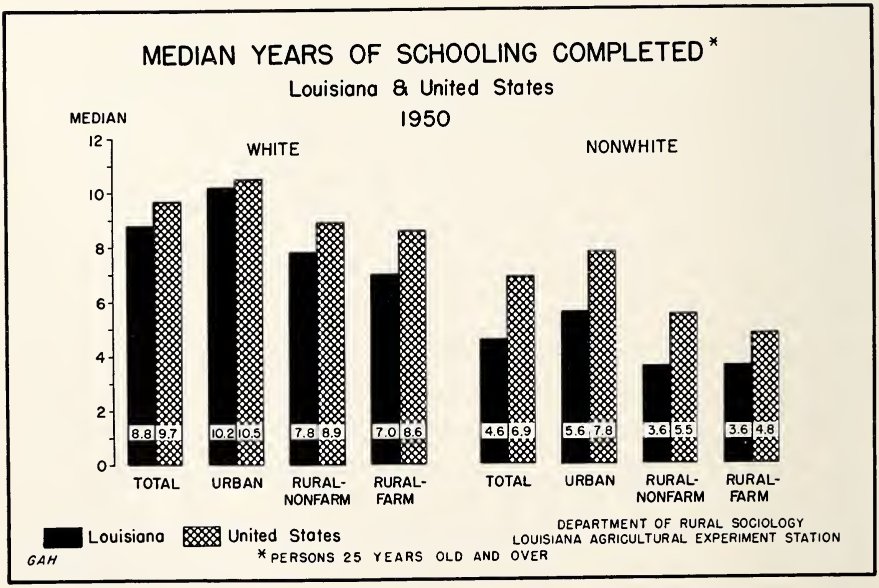


FIGURE 15.—Median Years of Schooling Completed, Louisiana and The United States, 1950, by Race. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 20; and United States Census, 1950, U. S. Summary, "General Characteristics," Vol. II, Part I, Table 44.)

generally. Nonwhites 25 years of age and over in Louisiana in 1950 had a median years of schooling completed of 4.6 as compared to 6.9 for those in the nation. The residential differentials in educational attainment as described among whites also characterized the nonwhites except that they are more pronounced. Louisiana's nonwhites do not fare quite as well as whites in comparisons with similar groups in the nation as a whole. The highest educational attainment among nonwhites 25 years of age and over in Louisiana is found among those in urban places. These persons had a median years of schooling completed of 5.6 years. However, the comparable group in the nation had a median years of schooling completed of 7.8 years. Among rural-nonfarm adult nonwhites, those in Louisiana had a median years of schooling completed of 3.6 years as compared to 5.5 for those in the nation generally. Similar figures for the rural-farm nonwhites are 3.6 and 4.8, respectively.

Clearly evident also from an analysis of Figure 15 is the fact that nonwhites 25 years of age and over have a lower educational achievement than whites. This characteristic is true of both the state and the nation. In each of the residential categories, the nonwhites in the state have a lower educational attainment than whites, a situation which also characterizes the nation as a whole.

Analysis of the median years of schooling completed by persons 25 years of age and over in 1950, by parishes, shows considerable variation. In some areas of the state, educational attainment as measured by median years of schooling completed is much lower than in other localities. Figures 16 and 17 have been prepared to demonstrate variations in median years of schooling completed by adult males and females in Louisiana in 1950, by parishes. The median years of schooling completed by males was 7.4 in 1950. However, Figure 16 shows that this median was obtained in only 10 parishes. For the most part, the parishes with comparatively high median years of schooling among adult males are the most urban ones in the state or are adjacent to a large urbanized area. The only exception to this generalization appears to be Vernon Parish, which had a relatively high median years completed by its adult males.

On the other hand, one parish had a very low median years of schooling for its adult male population in 1950. In St. Martin Parish, adult males had completed only 3.3 years. Besides St. Martin, 19 other parishes had median years of schooling completed among their adult males of 5.4 years or less. For the most part, these areas of low educational attainment among adult males are located in the Red River Delta Area, the Mississippi Delta Area, the Southwest Rice Area, the South Central Mixed Farming Area, and the Sugar Bowl Area.

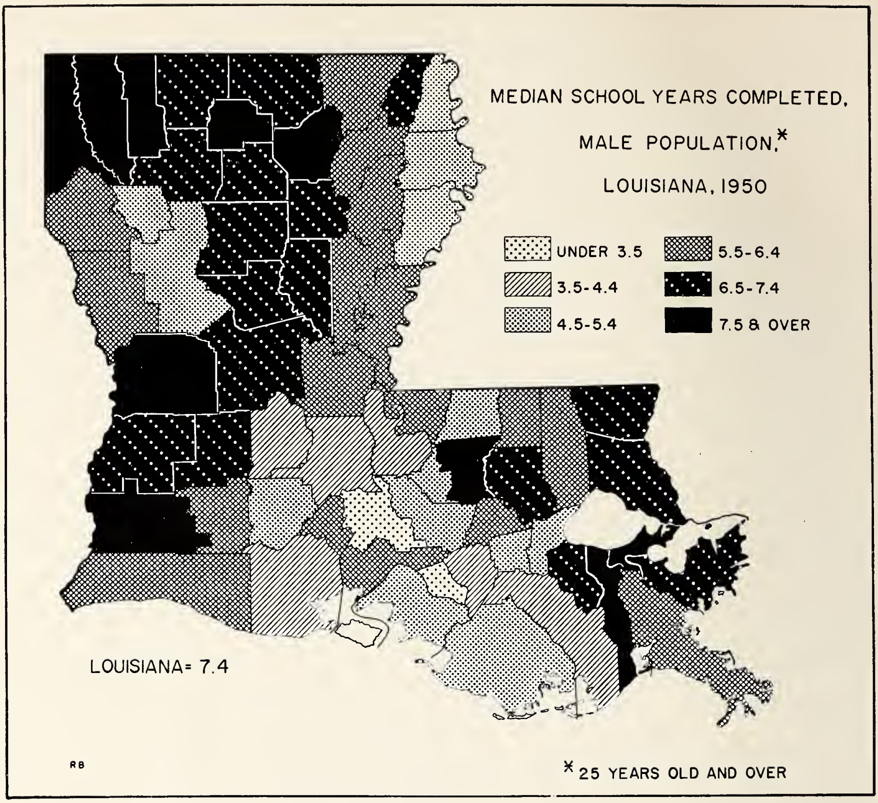


FIGURE 16.—Median School Years Completed, Male Population, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 42.)

Females 25 years old and over had a higher median years of schooling in 1950 than did the males. Their median was 7.9 years as compared to 7.4 years for males. Figure 17 shows parish variations in the median years of schooling for adult females in 1950. A study of this map reveals that high median years of schooling among females existed in 24 parishes. These are located principally in the Red River Delta Area, the North Louisiana Uplands Area, the North Central Cut-Over Area, the West Central Cut-Over Area, the Florida Parishes Area, and the New Orleans Truck and Fruit Area. Adult females recorded low educational attainments in the Sugar Bowl Area, the South Central Mixed Farming Area, and the Southwest Rice Belt. Several of the parishes in these areas had median years of schooling of 5.4 years or less for their adult females. St. Martin Parish recorded the lowest median years of schooling for females (3.8 years).

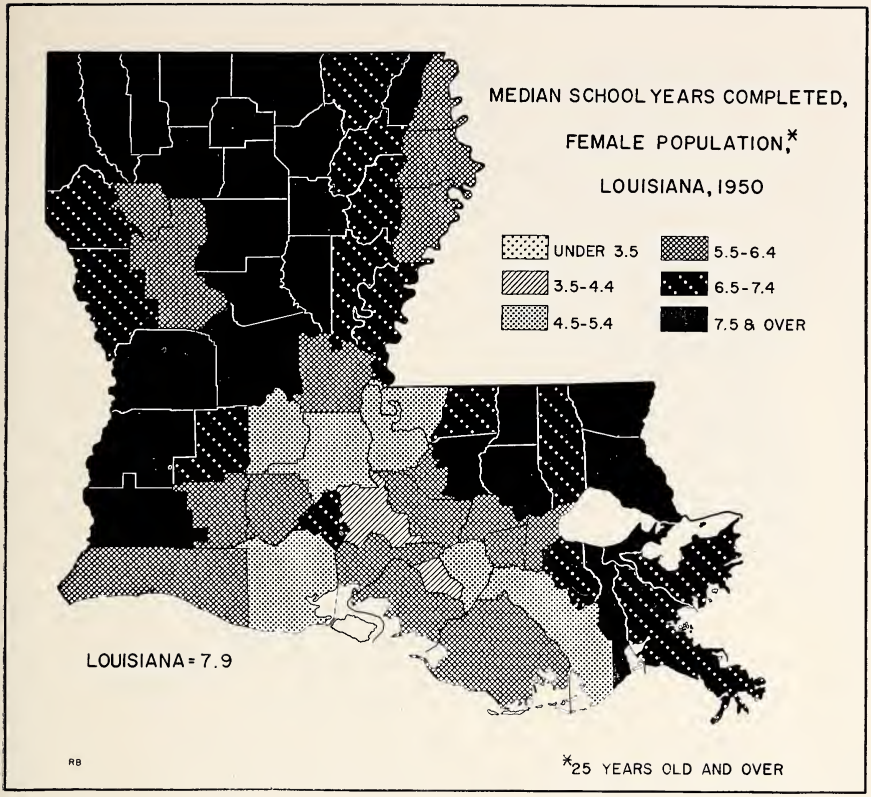


FIGURE 17.—Median School Years Completed, Female Population, Louisiana, 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 42.)

Farm people have lower educational achievements than persons in the other residential categories. The median years of schooling for this group was only 5.6 years. Figure 18 shows the median years of schooling of the rural-farm population 25 years of age and over in 1950, by parishes. Four parishes—Beauregard, Vernon, LaSalle, and East Baton Rouge—had median years of schooling of 7.5 years and over for their adult rural-farm populations. These compare favorably with educational attainment in the other residential areas. Generally, farm people in the North Louisiana Uplands Area, the North Central Cut-Over Area, the West Central Cut-Over Area, and the Florida Parishes Area had higher educational attainment than farm people in the other areas of the state. Low educational attainment among the adult farm population characterizes the Sugar Bowl Area, the South Central Mixed Farming Area, the Southwest Rice Area, the Red River Delta Area, and the Mississippi Delta Area. In fact,

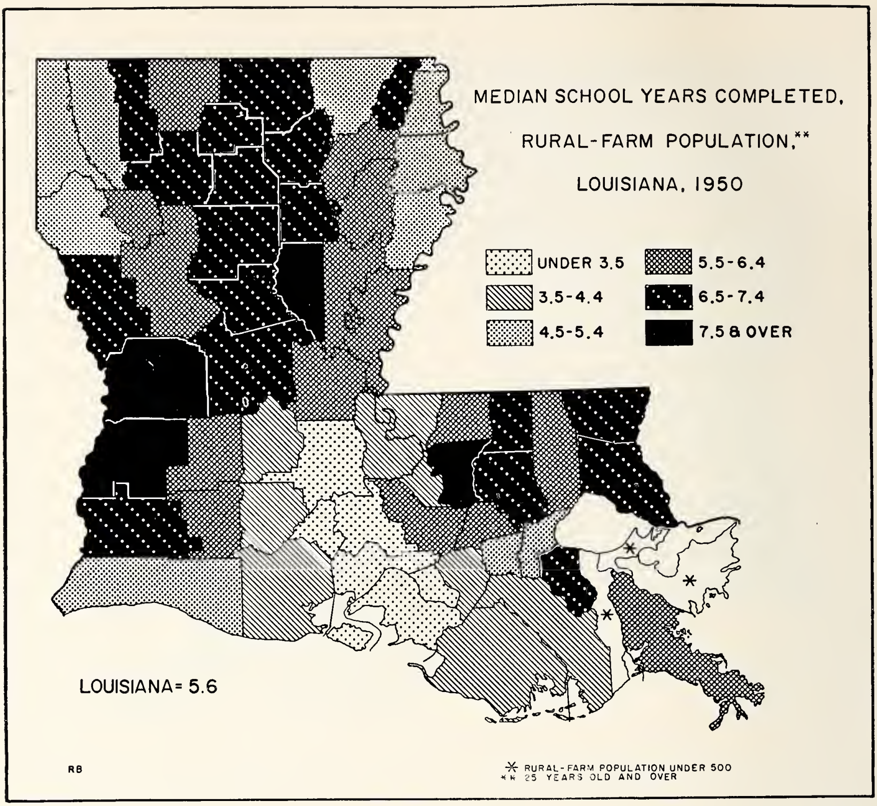


FIGURE 18.—Median School Years Completed, Rural-Farm Population, 1950. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 49.)

in 1950, five parishes had median years of schooling completed among farm people of less than 3.5 years. These were St. Landry, Lafayette, St. Martin, Iberia, and St. Mary parishes.

The variations in educational attainment which have been noted among the different parishes seem to result from the existence of either (1) a high proportion of Negroes in the population or (2) a high proportion of persons with Acadian French cultural heritage. It seems that the low educational attainment of the people of the Red River Delta Area and the Mississippi Delta Area results from a concentration of Negroes in the population who have low educational attainments. The low educational status of people in the Southwest Rice Area, the South Central Mixed Farming Area, and the Sugar Bowl Area probably can be attributed to the prevalence of the Acadian French culture. Many of the farm people with Acadian French cultural backgrounds still do not speak English as their native tongue and have not yet been completely absorbed into the greater society. Therefore, they tend to remain somewhat apart and have status as a minority group with a different culture from the larger society. This fact probably is responsible for their low average educational attainment.

In order to demonstrate the differentials in educational attainment by race, an analysis has been made of the proportions of people 25 years of age and over who had no schooling, who attended elementary school, who attended high school, and who attended college. This investigation has been conducted for each of the different residential areas. Table IV provides a summary of these findings. In 1950, among the population 25 years of age and over, 9.4 per cent had had no schooling, 53.4 per cent had attended elementary school, 26.7 per cent had attended high school, and 10.5 per cent had attended college. Whites had a much lower percentage with no schooling (6.1 per cent) than nonwhites (16.9 per cent). Also, whites had a much larger proportion that had attended college than nonwhites (13.9 per cent as compared to 2.6 per cent).

In considering educational attainment by residence, one finds that the data in Table IV clearly show that the urban population has the lowest proportion with no schooling and the highest proportion that attended college. The rural-nonfarm population stands in an intermediate position, and the rural-farm population has the largest proportion with no schooling and the lowest percentage that had attended college. In each of these residential areas, nonwhites had higher proportions with no schooling and smaller percentages that had attended college. For instance, among adult nonwhites in the rural-farm population, almost one-fourth (23.2 per cent) had no schooling as compared to one-tenth (10.2 per cent)

TABLE IV.—Educational Attainment of the Population 25 Years of Age and Over, by Race and Residence, Louisiana, 1950

Population	No Schooling	Attended Elementary	Attended High School	Attended College
		(Percentages)		
Total Population	*9.4*	*53.4*	*26.7*	*10.5*
Whites	6.1	45.7	34.3	13.9
Nonwhites	16.9	71.4	9.1	2.6
Urban Population	*5.9*	*48.3*	*31.7*	*14.1*
Whites	3.6	38.9	39.3	18.2
Nonwhites	11.8	71.7	12.8	3.7
Rural-Nonfarm Population	*13.8*	*56.9*	*22.3*	*7.0*
Whites	9.7	51.4	29.6	9.3
Nonwhites	23.4	69.1	5.2	1.8
Rural-Farm Population	*14.8*	*65.5*	*16.0*	*3.7*
Whites	10.2	61.5	23.1	5.2
Nonwhites	23.2	72.6	3.4	0.8

Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Tables 43 and 48a.

TABLE V.—Educational Attainment of the Rural-Farm Population 25 Years of Age and Over, by Race, Louisiana, 1950

Parish	Total				White				Nonwhite			
	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College
Acadia	28.4	56.0	12.9	2.7	26.1	56.6	14.4	2.9	49.2	50.0	.	0.8
Allen	14.0	66.4	17.3	2.3	9.9	67.4	20.0	2.7	38.7	60.0	1.3	. .
Ascension	14.2	65.1	17.7	3.0	10.2	62.8	23.4	3.6	25.9	71.9	1.1	1.1
Assumption	24.2	66.0	7.5	2.3	22.0	63.7	10.7	3.6	28.2	69.8	2.0	. .
Avoyelles	12.2	70.9	14.2	2.7	10.5	68.6	17.6	3.3	18.4	79.4	2.0	0.2
Beauregard	3.5	65.6	26.0	4.9	3.1	65.1	26.8	5.0	14.3	80.9	.	4.8
Bienville	4.9	66.9	23.9	4.3	2.7	56.4	34.5	6.4	7.8	80.8	9.9	1.5
Bossier	9.3	72.1	14.2	4.4	2.7	56.5	32.2	8.6	13.2	81.1	3.8	1.9
Caddo	12.5	71.1	12.5	3.9	2.9	49.3	36.7	11.1	16.4	79.9	2.7	1.0
Calcasieu	12.1	61.3	22.9	3.7	8.0	62.8	25.1	4.1	46.4	48.2	5.4	. .
Caldwell	5.3	68.7	22.1	3.9	4.2	65.6	25.8	4.4	9.2	79.6	9.2	2.0
Cameron	18.3	70.4	9.6	1.7	18.1	69.5	10.5	1.9	20.0	80.0	. .	. .
Catahoula	11.0	67.5	16.7	4.8	2.9	67.2	24.1	5.8	27.2	68.0	1.9	2.9
Claiborne	8.1	66.2	21.4	4.3	1.5	50.9	39.5	8.1	13.0	77.6	7.9	1.5
Concordia	10.0	73.0	14.0	3.0	1.0	57.4	33.5	8.1	15.1	82.0	2.9	. .
DeSoto	7.9	72.5	14.7	4.9	1.8	56.0	31.8	10.4	12.6	85.0	1.7	0.7
E. Baton Rouge	10.4	48.5	27.7	13.4	2.4	38.5	40.5	18.6	26.0	67.8	3.1	3.1
E. Carroll	11.9	75.4	10.5	2.2	4.1	67.5	22.3	5.1	16.5	80.2	2.9	0.4
E. Feliciana	9.0	71.2	15.4	4.4	1.1	38.7	46.2	14.0	11.9	83.4	3.9	0.8
Evangeline	27.8	60.3	10.3	1.6	19.6	65.3	13.1	2.0	55.1	43.8	0.7	0.4
Franklin	10.1	72.6	14.1	3.2	4.5	70.3	20.8	4.4	20.7	76.8	1.6	0.9
Grant	6.3	67.4	23.3	3.0	2.9	64.7	29.2	3.2	18.1	76.7	2.6	2.6
Iberia	33.4	54.4	9.4	2.8	25.9	55.6	14.7	3.8	45.4	52.3	0.9	1.4
Iberville	15.6	60.5	18.3	5.6	11.6	54.4	25.6	8.4	23.6	72.6	3.8	. .
Jackson	5.2	71.8	18.4	4.6	4.0	65.5	24.8	5.7	8.0	86.0	4.0	2.0

(Continued)

TABLE V.—Educational Attainment of the Rural-Farm Population 25 Years of Age and Over, by Race, Louisiana, 1950 (Cont'd)

Parish	Total				White				Nonwhite			
	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College
Jefferson	9.0	53.9	27.0	10.1	9.6	51.8	27.7	10.9	...	83.3	16.7	. .
Jefferson Davis	19.6	59.4	17.8	3.2	16.1	60.8	19.5	3.6	51.7	46.7	1.6	. .
Lafayette	31.8	54.5	9.8	3.9	21.5	60.9	12.6	5.0	66.0	33.6	0.4	. .
Lafourche	25.3	62.3	9.2	3.2	27.3	57.1	11.5	4.1	18.3	80.1	1.6	. .
LaSalle	1.6	69.9	23.3	5.2	1.7	69.4	23.8	5.1	...	80.0	13.3	6.7
Lincoln	4.5	62.0	27.4	6.1	0.5	53.2	37.6	8.7	11.8	78.8	8.0	1.4
Livingston	5.1	67.4	23.8	3.7	4.7	65.5	25.7	4.1	9.4	85.9	4.7	. .
Madison	12.9	70.6	13.2	3.3	4.9	55.6	31.7	7.8	17.5	79.4	2.4	0.7
Morehouse	9.6	76.0	12.1	2.3	3.8	62.2	28.4	5.6	12.6	83.2	3.7	0.5
Natchitoches	16.4	67.5	13.5	2.6	6.8	65.1	23.6	4.5	26.3	70.0	3.1	0.6
Ouachita	6.4	63.1	25.0	5.5	2.3	58.6	32.1	7.0	13.8	71.4	12.0	2.8
Plaquemines	10.5	70.6	14.7	4.2	6.3	69.0	19.0	5.7	21.9	75.0	3.1	.
Pointe Coupee	24.4	62.5	8.8	4.3	14.5	57.7	18.2	9.6	32.1	66.3	1.4	0.2
Rapides	7.8	68.6	18.3	5.3	4.7	65.4	23.2	6.7	18.7	79.9	1.1	0.3
Red River	17.2	65.0	15.5	2.3	2.9	64.6	28.5	4.0	31.4	65.4	2.7	0.5
Richland	8.3	73.7	14.9	3.1	3.6	68.8	22.5	5.1	14.8	80.6	4.3	0.3
Sabine	5.4	67.7	24.3	2.6	4.2	66.6	26.7	2.5	17.9	79.1	.	.
St. Bernard	12.3	63.1	20.0	4.6	11.7	63.3	20.0	5.0	20.0	60.0	20.0	. .
St. Charles	13.7	56.4	20.2	9.7	6.9	52.9	26.4	13.8	29.7	64.9	5.4	. .
St. Helena	3.5	69.4	23.4	3.7	1.0	52.0	41.8	5.2	5.8	86.5	5.5	2.2
St. James	19.6	62.5	12.8	5.1	6.5	58.7	24.8	10.0	32.1	66.3	1.2	0.4
St. John the Baptist	18.9	62.1	14.8	4.2	7.3	55.4	30.1	7.2	30.2	68.6	.	1.2
St. Landry	31.3	59.5	7.3	1.9	23.4	61.1	12.0	3.5	40.3	57.7	1.9	0.1
St. Martin	41.7	49.5	7.4	1.4	31.0	55.6	11.3	2.1	60.8	38.6	0.6	. .
St. Mary	33.5	54.9	8.9	2.7	23.5	46.9	23.0	6.6	39.0	59.3	1.1	0.6

(Continued)

TABLE V.—Educational Attainment of the Rural-Farm Population 25 Years of Age and Over, by Race, Louisiana, 1950 (Cont'd)

Parish	Total				White				Nonwhite			
	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College	No Schooling	Attended Elementary	Attended High School	Attended College
St. Tammany	3.6	68.0	22.9	5.5	1.8	65.5	26.4	6.5	12.0	80.4	6.5	1.1
Tangipahoa	15.3	63.1	18.3	3.3	13.6	60.7	21.8	3.9	21.1	71.3	6.3	1.3
Tensas	12.7	72.8	9.3	5.2	2.3	59.6	22.4	15.7	17.5	78.8	3.3	0.4
Terrebonne	21.4	66.9	8.7	3.0	17.7	64.4	13.5	4.4	27.8	71.2	0.5	0.5
Union	9.2	66.7	20.1	4.0	6.3	63.4	26.1	4.2	16.1	74.6	5.7	3.6
Vermilion	28.2	59.4	10.1	2.3	27.2	59.7	10.7	2.4	41.8	54.4	2.5	1.3
Vernon	3.3	66.9	26.0	3.8	3.0	66.5	26.6	3.9	14.3	80.9	4.8	. .
Washington	3.6	64.5	27.2	4.7	2.3	57.5	33.9	6.3	7.2	83.4	9.1	0.3
Webster	7.5	67.9	20.7	3.9	3.2	56.4	33.9	6.5	12.7	81.6	4.9	0.8
W. Baton Rouge	34.3	48.7	13.2	3.8	13.9	48.1	29.1	8.9	47.9	49.2	2.5	0.4
W. Carroll	5.7	70.1	21.1	3.1	2.8	70.3	23.3	3.6	21.3	68.9	9.2	0.6
W. Feliciana	15.7	70.0	8.6	5.7	3.4	27.1	39.0	30.5	18.5	79.9	1.6	. .
Winn	6.3	65.4	24.6	3.7	3.2	64.3	28.2	4.3	21.5	71.0	6.6	0.9
Louisiana	14.8	65.5	16.0	3.7	10.2	61.5	23.1	5.2	23.2	72.6	3.4	0.8

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Tables 48 and 48a (Orleans Parish is not included in the above table because it does not have any rural-farm population.)

among whites. Only 0.8 per cent of the adult nonwhites in the rural-farm population had attended college. Among rural-farm whites, 5.2 per cent had attended college.

There is much variation in educational attainment among parishes. In order to illustrate differential educational achievement by race in the rural-farm populations of the individual parishes, Table V is presented. Among the rural-farm people 25 years of age and over, in several of the parishes about one-third of the people have had no schooling. Among these are Iberia, Lafayette, St. Landry, St. Martin, St. Mary, and West Baton Rouge parishes. In others, as many as one-fourth of the rural-farm people have had no schooling. In this category are Acadia, Assumption, Evangeline, Lafourche, Pointe Coupee, Terrebonne, and Vermilion parishes.

The high proportion of adults in the rural-farm population without any formal education results to a considerable degree from the high proportion of nonwhites who have never attended school. Approximately one-half of the nonwhites in the rural-farm population 25 years of age and over have never attended school in Acadia, Calcasieu, Evangeline, Iberia, Jefferson Davis, Lafayette, St. Martin, and West Baton Rouge parishes. Also, in eight of the other parishes approximately one-third of the nonwhite adults in the rural-farm populations had never attended school.

Although white persons 25 years of age and over in the rural-farm populations of the different parishes generally have much lower proportions with no schooling, in several parishes approximately one-fifth had received no formal education. Falling into this category are Acadia, Assumption, Cameron, Evangeline, Iberia, Lafayette, Lafourche, St. Landry, St. Martin, St. Mary, and Vermilion parishes. Therefore, both whites and nonwhites in these areas have large proportions without formal schooling.

The above data clearly indicate that in many of the parishes there are large proportions of rural-farm adults who have never attended school at all. The proportions are greater among nonwhites, although in many parishes high proportions of the rural-farm white adults also have had no schooling. If rural-farm people seem to react slowly to the introduction of complicated and new ideas, it is not surprising in view of the large numbers who have had no formal schooling.

The decade between 1940 and 1950 witnessed considerable improvement in the educational status of Louisiana's adults. Figure 19 illustrates the gains which were made during this period, by showing the median years of schooling for persons 25 years of age and over by race and residence in 1940 and 1950. The median years of schooling completed among the whites increased from 8.1 to 8.8 years. Similar increases occurred among the nonwhites from 3.9 years to 4.6 years. The white population showed an increase in the median years of schooling completed in each of the residential areas except the rural-nonfarm. In the latter a slight decrease in the median took place between 1940 and 1950. There are two possible explanations of this occurrence: (1) there is an educational selectivity of those persons with little schooling taking place in the migrations from the farms and the cities to the nonfarm areas; (2) the decrease in median years of schooling has resulted from changes in the definitions of residence which were used in the 1950 Census. Among nonwhites, no such decrease in median school years completed occurred in the rural-nonfarm population. Nonwhites showed gains in each of the residential areas. In the case of whites the greatest increases in the median years of schooling completed was recorded in the urban population. However, among nonwhites the greatest gain occurred in the rural-farm population.

It should be pointed out that the educational attainment of the population 25 years of age and over reflects the achievements of the school system of the state as it existed prior to the 1930's. The tremendous effort which the state has made in educating its people in the last two decades is not evident in these figures because they do not include the younger

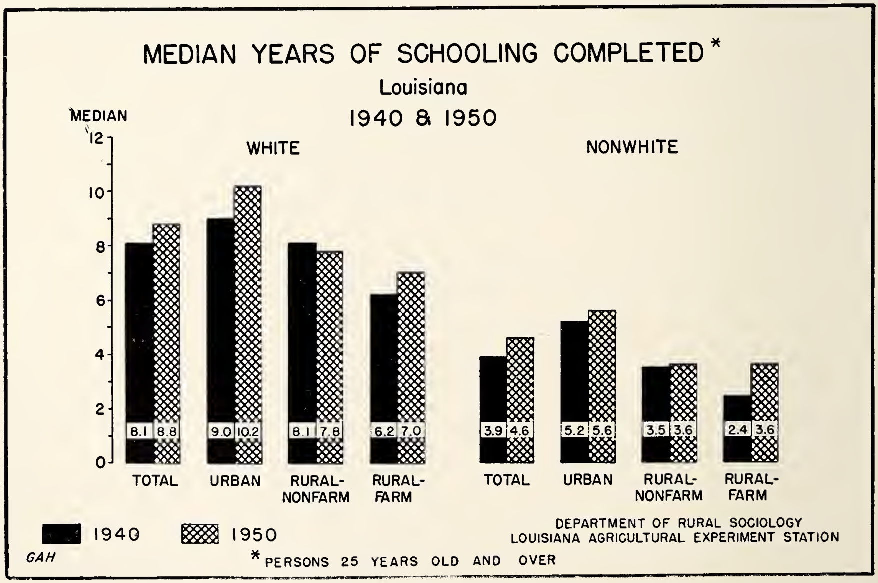


FIGURE 19.—Median Years of Schooling Completed, Louisiana, 1940 and 1950. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 20.)

generations who have not, in most cases, completed their educations. Future years should bring about a significant increase in the educational attainment of the adult population as the students now in the school system complete their schooling. It is also probable that the large majority of the persons in 1950 with no schooling are in the older ages and that they will be replaced with a more educated citizenry when they are removed from the population through death.

MARITAL STATUS

The data on the marital status of the population 14 years of age and over in 1950 show that males live in a married state to a greater extent than do females. This same situation prevails in the urban population. However, in the rural-nonfarm and rural-farm populations, females are married in greater proportions than are men. This relationship exists among both whites and nonwhites. (See Table VI.) Among whites, 70.2

TABLE VI.—Marital Status of Persons 14 Years Old and Over, Louisiana, 1950, by Race and Residence

Area and Color	Total 14 Years Old and Over	Single		Married		Widowed/Divorced	
		Number	Per Cent	Number	Per Cent	Number	Per Cent
			MALE				
The State							
White	636,518	160,207	25.2	446,887	70.2	29,424	4.6
Nonwhite	277,497	76,167	27.4	183,168	66.0	18,162	6.5
Urban							
White	366,359	87,355	23.8	261,519	71.4	17,485	4.8
Nonwhite	143,250	35,664	24.9	97,463	68.0	10,123	7.1
Rural-Nonfarm							
White	151,646	37,870	25.0	106,591	70.3	7,185	4.7
Nonwhite	63,734	17,811	27.9	41,122	64.5	4,801	7.5
Rural-Farm							
White	118,513	34,982	29.5	78,777	66.5	4,754	4.0
Nonwhite	70,513	22,692	32.2	44,583	63.2	3,238	4.6
			FEMALE				
The State							
White	657,973	123,716	18.8	448,234	68.1	85,933	13.1
Nonwhite	310,580	61,614	19.8	195,195	62.8	53,771	17.3
Urban							
White	400,244	77,738	19.4	263,355	65.8	59,151	14.8
Nonwhite	173,552	31,128	17.9	107,794	62.1	34,630	20.0
Rural-Nonfarm							
White	149,674	24,706	16.5	107,004	71.5	17,964	12.0
Nonwhite	68,217	13,250	19.4	42,547	62.4	12,420	18.2
Rural-Farm							
White	108,055	21,272	19.6	77,965	72.2	8,818	8.2
Nonwhite	68,811	17,236	25.0	44,854	65.2	6,721	9.8

Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 21.

per cent of the men and 68.1 per cent of the women were married in 1950. Similar figures for nonwhites were 66.0 and 62.8 per cent. In the urban population, 71.4 per cent of the white men and 62.8 per cent of the white females were married in 1950. For nonwhites in the urban population, 68.0 per cent of the males and 62.1 per cent of the females were listed as married. The opposite relationship prevails in the rural-nonfarm and rural-farm populations. Among whites, 70.3 per cent of the males and 71.5 per cent of the females in the rural-nonfarm population were married, and among nonwhites, 64.5 per cent of the males and 62.4 per cent of the females were in this category. Similar figures for the rural-farm white population are 66.5 per cent for males and 72.2 per cent for females. For nonwhites the percentages are 63.2 and 65.2, respectively.

The data on marital status of the population 14 years of age and over also show that the males of the urban population have the largest proportion in the married classification, followed by those in the rural-nonfarm and rural-farm populations in declining order. This relationship prevails among both whites and nonwhites. However, in each of the residential areas, a smaller proportion of nonwhites is married than of whites. The marital status pattern of the females is the direct reverse of that for males. Women in the urban population are listed as married in least proportion, followed by those in the rural-nonfarm and rural-farm populations in increasing order. This same pattern characterized whites and nonwhites. Also, a smaller proportion of the nonwhite women in each residential area is married than of the white women. Thus, the rural-farm population is characterized by the largest proportion of married women and the smallest proportion of married men. The urban population has the highest proportion of married men and the smallest proportion of married women. The rural-nonfarm population has an intermediate position insofar as marital status is concerned. The same pattern prevails among whites and nonwhites except that in all cases the proportion married among nonwhites is smaller than that among whites.

The data clearly show that men live in a widowed and divorced status to a much lesser extent than women in each of the residential areas. In the state in 1950, 4.6 per cent of the white men and 6.5 per cent of the nonwhite men were widowed or divorced. Among women, similar figures were 13.1 per cent for whites and 17.3 per cent for nonwhites. There is no great variation by residence among the proportions of men listed as widowed or divorced. In the urban population, 4.8 per cent of the white and 7.1 per cent of the nonwhite men were in this category. For the rural-nonfarm males, 4.7 per cent of the whites and 7.5 per cent of the nonwhites were widowed or divorced. In the rural-farm population, only

4.0 per cent of the white and 4.6 per cent of the nonwhite men had lost their wives through divorce or death and had not remarried. Among women in the urban population, 14.8 per cent of the whites and 20.0 per cent of the nonwhites were divorced or widowed. Similar figures for the rural-nonfarm women in 1950 were 12.0 per cent and 18.2 per cent, respectively. Women in the rural-farm population are widowed or divorced to the least extent of any of the residential areas. Among farm women only 8.2 per cent of the whites and 9.8 per cent of the nonwhites were in that category.

In each of the residential areas, nonwhites have higher proportions in the widowed or divorced category than whites. This holds true for males as well as females. Furthermore, women of both racial groups have considerably higher proportions of their members in the widowed or divorced category than men. It is interesting to note that one-fifth of the nonwhite women 14 years of age and over in the urban population in 1950 were classified as widowed or divorced.

A larger proportion of males than females are single in each of the residential areas. In the state, 25.2 per cent of the white males and 27.4 per cent of the nonwhite males were single in 1950. Comparable figures for females were 18.8 and 19.8 per cent. Among males, there is an increasing proportion of single persons as one goes from the urban, rural-nonfarm, and rural-farm areas. In other words, the urban population has the smallest proportion of single persons among its males, followed by the rural-nonfarm, and finally the rural-farm, which has the largest proportion of single males. This observation characterized whites and nonwhites alike. Among the women, a similar pattern is found for the nonwhites, but the whites do not conform. Among the nonwhites, women are single to the least extent in the urban areas, followed by those in the rural-nonfarm areas, and finally, the rural-farm area, which has the largest proportion of single women. Among whites, the largest proportion of single women is found in the rural-farm area, but the smallest proportion is in the rural-nonfarm areas rather than the urban localities. In all cases, the proportion of single persons is greater among nonwhite women than among white women except in the urban population, where the reverse is true.

The findings of this analysis support the contention that the rural-farm areas are characterized by larger proportions of single males than the other residential areas. However, the fact that the rural-farm areas also have the largest proportions of single women is not generally recognized. Most people attribute this characteristic to the urban population. Although the proportion of single women in the urban areas is high, it is not as great as that found in the rural-farm areas of the state. Among men, the urban areas have the largest proportion married, the rural-nonfarm areas rank next, and the rural-farm areas have the smallest proportion in that category. Just the opposite exists among women. The urban areas have the smallest proportion, the rural-nonfarm areas rank second, and the rural-farm areas have the largest propotion of women classified as married. The proportion of males widowed or divorced does not vary greatly from one residential area to another. Only rural-farm nonwhite males have a significantly lower proportion in this category than that found in the other areas. Among females, however, the urban areas have the largest proportion widowed or divorced, the rural-nonfarm ranks second, and the rural-farm area has the least proportion of women who have lost their husbands through death or divorce and who have not remarried.

OCCUPATIONAL STATUS

An analysis of occupational status in 1950 reveals that farmers and farm managers constituted 9.8 per cent and that farm laborers and foremen made up 6.5 per cent of the experienced civilian labor force.[5] (See Table VII.) Therefore, persons engaged in agricultural occupations make up about one-sixth of the experienced civilian labor force. When this analysis is made by sex, the data reveal that a much larger proportion of the experienced civilian male labor force is made up of persons engaged in agricultural endeavors. In fact, 12.8 per cent were classified in 1950 as farmers and farm managers and 6.8 per cent as farm laborers and foremen. Thus, approximately one-fifth of the experienced male labor force of the state in 1950 was engaged in agriculture. The situation among the experienced civilian female labor force is somewhat different. Only 1.3 per cent of the women were classified as farmers and farm managers and 5.4 per cent were listed as farm laborers and foremen. Therefore, a much smaller proportion of the experienced civilian female labor force is engaged in agricultural occupations than among the males.

In studying the composition of the experienced civilian labor force by residential areas, one finds that persons in the rural-farm population are engaged in considerable numbers in occupations other than those connected with agriculture. Actually, in 1950 only 49.5 per cent of the experienced civilian labor force in the rural-farm areas were classified as farmers and farm managers and 23.0 per cent as farm laborers and foremen. Therefore, approximately one-fourth of the workers in the rural-farm

---

[5] The experienced civilian labor force is composed of persons 14 years of age and over classified as employed workers or as unemployed workers or as unemployed with previous work experience.

TABLE VII.—Occupation of the Experienced Civilian Labor Force, Louisiana, 1950, by Sex

Occupational Category	Total		Male		Female	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Professional, technical, and kindred	70,649	7.7	41,258	6.1	29,391	12.3
Farmers and farm managers	90,019	9.8	87,042	12.8	2 977	1.3
Managers, officials, and proprietors, except farm	74,968	8.2	64,237	9.5	10,731	4.5
Clerical and kindred workers	87,419	9.5	36,759	5.4	50,660	21.3
Sales workers	57,513	6.3	36,708	5.4	20,805	8.7
Craftsmen, foremen, and kindred workers	106,843	11.7	104,926	15.4	1,917	0.8
Operatives and kindred workers	138,496	15.1	117,239	17.3	21,257	8.9
Private household workers	45,918	5.0	1,503	0.2	44,415	18.7
Service workers, except private household	73,476	8.0	38,548	5.7	34,928	14.7
Farm laborers and foremen	59,148	6.5	46,200	6.8	12,948	5.4
Laborers, except farm and mine	91,245	9.9	89,197	13.1	2,048	0.9
Occupation not reported	21,523	2.3	15,473	2.3	6,050	2.5
Total Experienced Labor Force	917,217	100.0	679,090	100.0	238,127	100.0

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 28.

areas follow occupations not directly connected with agriculture. (Table VIII.) The largest occupational group in this category is operatives and kindred workers, in which 6.6 per cent of the rural-farm experienced civilian labor force was engaged in 1950. Also in the rural-farm labor force a substantial group was engaged as craftsmen, foremen, and kindred workers (4.3 per cent). The next largest occupational group was laborers, except farm and mine, which accounted for 4.2 per cent of the experienced civilian labor force in rural-farm areas. It is of interest to note that 2.2 per cent of the experienced civilian labor force in rural-farm areas were classified as professional persons.

An analysis of the occupational status of the experienced civilian labor force in rural-farm areas, by sex, shows that in 1950 a much larger proportion of the males were classified as farmers and farm managers (55.7 per cent) than the females (11.2 per cent). On the other hand, males in the experienced civilian labor force in rural-farm areas were farm laborers and foremen (20.1 per cent) to a considerably smaller extent than women (40.5 per cent). Of those women not in agricultural occupations, about one-tenth (10.7 per cent) were employed as private household workers. There was a relatively large proportion (8.8 per cent) of the females in the experienced civilian labor force in the rural-farm areas classified as professional, technical, and kindred workers. Furthermore, 6.0 per cent of them were service workers, except private household. In contrast, the males in the experienced civilian labor force in rural-farm areas who were not in agricultural pursuits worked in greatest proportion as operatives and kindred workers (7.1 per cent); laborers, except farm and mine (4.9 per cent); and craftsmen, foremen, and kindred workers (4.9 per cent). Only a few males in the experienced civilian labor force in rural-farm areas were professionals (1.2 per cent).

The occupational composition of the experienced civilian labor force of the rural-nonfarm areas is very different from that of the rural-farm localities. This further emphasizes the fact that the rural-nonfarm population is probably more closely related to the urban than to the rural-farm people. Most of the people in the experienced civilian labor force in rural-nonfarm areas in 1950 were engaged as operatives and kindred workers (19.7 per cent); laborers, except farm and mine (16.3 per cent); and craftsmen, foremen, and kindred workers (13.9 per cent). Other occupations found in significant proportions among the experienced civilian labor force of rural-nonfarm areas in 1950 were farm laborers and foremen (9.1 per cent); managers, officials, and proprietors, except farm (7.6 per cent); professional, technical, and kindred persons (6.4 per cent); service workers, except private household (6.3 per cent); and sales workers (5.2 per cent).

TABLE VIII.—Occupation of the Experienced Civilian Labor Force, by Residence, Louisiana, 1950

Occupational Category	URBAN			RURAL-NONFARM			RURAL FARM		
	Per Cent			Per Cent			Per Cent		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Professional, technical, and kindred	9.8	8.5	12.5	6.4	4.5	13.6	2.2	1.2	8.8
Farmers and farm managers	0.3	0.4	0.1	2.2	2.6	0.5	49.5	55.7	11.2
Managers, officials, and proprietors, except farm	10.3	12.9	4.5	7.6	8.1	5.8	1.9	1.7	2.5
Clerical and kindred workers	13.4	8.0	25.3	4.9	3.0	12.0	1.6	0.9	6.3
Sales workers	8.0	7.6	9.0	5.2	4.1	9.8	1.6	1.1	4.8
Craftsmen, foremen and kindred workers	13.1	18.7	9.0	13.9	17.4	0.6	4.3	4.9	0.3
Operatives and kindred workers	16.2	19.0	10.0	19.7	22.9	7.5	6.6	7.1	3.5
Private household workers	6.1	0.3	19.0	4.8	0.2	22.2	1.5	. .	10.7
Service workers, except private household	10.6	8.3	15.6	6.3	3.8	15.8	1.5	0.8	6.0
Farm laborers and foremen	0.6	0.7	0.3	9.1	9.7	7.2	23.0	20.1	40.5
Laborers, except farm and mine	9.6	13.6	0.8	16.3	20.2	1.2	4.2	4.9	0.4
Occupation not reported	2.0	2.0	2.0	3.6	3.5	3.8	2.1	1.6	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: United States Census, 1950, Louisiana, "Characteristics of the Population," Vol. II, Part 18, Table 28.

In examining the experienced civilian labor force in the rural-nonfarm areas by sex, one finds that the male labor force has essentially the same occupational composition as described for the total, and undoubtedly they determine the over-all occupational characteristics of the labor force of the area. When examined separately, the data show that males were more highly concentrated in operatives and kindred workers; laborers, except farm and mine; and craftsmen, foremen, and kindred workers than was indicated for the total labor force. The occupational status of women in the experienced civilian labor force of the rural-nonfarm area is very different from that of men. In 1950, the largest proportion (22.2 per cent) of the women were classified as private household workers. Other important occupations among women in the experienced civilian labor force of the rural-nonfarm areas in 1950 were service workers, except private household (15.8 per cent); professional, technical, and kindred workers (13.6 per cent); and clerical and kindred workers (12.0 per cent).

The most important occupational groups in the experienced civilian labor force of the urban places in 1950 were operatives and kindred workers (16.2 per cent); clerical and kindred workers (13.4 per cent); service workers, except private household (10.6 per cent); and managers, officials, and proprietors, except farm (10.3 per cent). Males were even more heavily concentrated in these occupations, excluding service workers, except private household. Only 8.3 per cent of the males in the experienced civilian labor force of the urban places were in this latter occupation. Also, males are employed in greater proportion as laborers, except farm and mine. In 1950, this occupational category included 13.6 per cent of the men in the experienced civilian labor force of the urban places. Women were concentrated in the following occupations: clerical and kindred workers (25.3 per cent); private household workers (19.0 per cent); service workers, except private household (15.6 per cent); professional, technical and kindred workers (10.0 per cent).

In order to demonstrate the differences which exist in the occupational statuses of whites and nonwhites, Table IX is presented, which shows the occupations of employed persons 14 years of age and over by sex, race, and residence. Readily evident from these data is the fact that nonwhites tend to be concentrated as private household workers and laborers of all types. In fact, only 0.5 per cent of the employed whites were private household workers, whereas 14.9 per cent of the nonwhites fell into that category. Among nonwhite females, 44.5 per cent were classified as private household workers as compared to only 1.9 per cent of the white females. Among the males, 27.0 per cent of the nonwhites were employed as laborers, except farm and mine. Only 7.0 per cent of the white

TABLE IX.—Occupations of Employed Persons 14 Years of Age and Over, by Sex, Race, Residence, Louisiana, 1950

Occupation	The State			Urban			Rural-Nonfarm			Rural Farm		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
						(Percentages)						
						White						
Professional, technical, and kindred workers	10.2	8.1	17.0	12.7	11.0	16.8	8.3	5.9	19.4	3.1	1.7	14.7
Farmers and farm managers	9.1	11.7	0.7	0.3	0.4	0.1	2.2	2.6	0.5	51.0	56.3	7.2
Managers, officials, and proprietors, except farm	11.6	13.1	6.5	14.1	17.2	6.2	10.9	11.3	9.0	3.0	2.7	5.1
Clerical and kindred workers	13.6	7.2	34.7	18.7	10.3	39.6	7.0	4.1	20.7	2.6	1.4	13.3
Sales workers	8.8	7.4	13.6	10.9	10.0	13.4	7.4	5.5	16.2	2.6	1.7	10.2
Craftsmen, foremen, and kindred workers	14.5	18.7	1.1	15.5	21.2	1.2	17.9	21.6	0.7	6.5	7.2	0.5
Operatives and kindred workers	15.2	17.3	8.5	15.0	17.5	8.8	21.8	24.7	8.3	8.2	8.5	5.3
Private household workers	0.5	. .	1.9	0.5	. . .	1.5	0.7	0.1	3.6	0.3		2.7
Service workers, except private household	6.0	4.4	11.3	7.1	5.7	10.6	6.0	3.9	16.1	1.8	1.0	8.4
Farm laborers, unpaid family workers	1.5	1.4	1.8	. . .	. . . .	. . .	0.4	0.3	0.5	8.5	6.8	22.9
Farm laborers, except unpaid, and farm foremen	2.1	2.5	0.6	0.2	0.2	0.1	3.9	4.4	1.6	6.8	7.2	4.2
Laborers, except farm and mine	5.5	7.0	0.5	3.9	5.3	0.4	11.7	14.0	1.0	3.9	4.2	0.6
Occupation not reported	1.4	1.2	1.8	1.1	1.1	1.3	1.8	1.6	2.4	1.7	1.3	4.9
						Nonwhite						
Professional, technical, and kindred workers	3.1	1.8	6.0	4.1	2.8	6.2	3.0	1.6	6.5	1.0	0.3	4.1
Farmers and farm managers	12.8	17.8	2.3	0.3	0.4	. .	2.4	3.1	0.7	48.9	56.7	15.0
Managers, officials, and proprietors, except farm	1.6	1.6	1.6	2.4	2.6	1.9	1.2	1.1	1.6	0.2	0.1	0.4
Clerical and kindred workers	1.3	1.3	1.3	2.1	2.3	1.8	0.5	0.5	0.4	0.1	0.1	0.2
Sales workers	1.1	1.0	1.4	1.6	1.6	1.6	0.9	0.7	1.3	0.1	0.1	0.3
Craftsmen, foremen, and kindred workers	4.9	7.1	0.4	6.8	11.0	0.5	4.7	6.5	0.2	0.8	1.0	0.1
Operatives and kindred workers	14.6	17.0	9.4	18.9	23.6	11.8	15.6	19.4	6.2	3.9	4.4	1.8
Private household workers	14.9	0.7	44.5	20.2	1.0	49.2	14.7	0.6	49.2	3.3	0.1	17.4

(Continued)

TABLE IX.—Occupations of Employed Persons 14 Years of Age and Over, by Sex, Race, Residence, Louisiana, 1950 (Cont'd)

Occupation	The State			Urban			Rural-Nonfarm			Rural Farm		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Service workers, except private household	12.4	8.8	19.9	19.1	15.9	24.1	7.5	4.0	16.1	1.1	0.4	4.0
Farm laborers, unpaid family workers	4.1	3.7	4.9	...	...	...	1.0	0.9	1.1	15.6	11.6	33.2
Farm laborers, except unpaid, and farm foremen	9.1	10.9	5.4	1.1	1.5	0.5	19.8	22.6	13.1	19.0	18.8	19.8
Laborers, except farm and mine	18.7	27.0	1.3	22.3	36.1	1.4	26.5	36.9	1.4	4.6	5.5	0.3
Occupation not reported	1.4	1.3	1.6	1.1	1.2	1.0	2.2	2.1	2.2	1.4	0.9	3.4

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 28a.

males were in this classification. Other jobs in which Negroes are concentrated are operatives and kindred workers; service workers, except private household; and farmers and farm managers. The white labor force is concentrated principally as operatives and kindred workers; craftsmen, foremen, and kindred workers; clerical and kindred workers; managers, officials, and proprietors, except farm; and professional, technical, and kindred workers.

This same situation prevails in the urban and rural-nonfarm populations. Negroes are heavily concentrated as private household workers and laborers, except farm and mine. Also, in the urban population a comparatively large segment of the Negro population is employed as service workers, except private household, and as operatives and kindred workers. In the rural-nonfarm population, a significant proportion of the Negroes is employed as farm laborers, except unpaid and farm foremen. Nearly one-half of the Negro women in the urban and rural-nonfarm populations are employed as private household workers. Among whites in the urban and rural-nonfarm populations relatively small proportions are employed in these jobs. In the urban population, whites are most often employed as clerical and kindred workers; craftsmen, foremen, and kindred workers; operatives and kindred workers; managers, officials, and proprietors except farm; professional, technical, and kindred workers; and sales workers. In fact, each of these occupational categories claims at least 10 per cent of the white labor force in cities. Among females in the urban population, 39.6 per cent of the whites were employed as clerical and kindred workers as compared to only 1.8 per cent of the nonwhites.

The composition of the labor force of whites and Negroes in the rural-farm population shows a considerable degree of similarity. The largest proportions of both races are classified as farmers and farm managers. The principal distinction between the occupational status of whites and Negroes on farms is that a much larger proportion of the latter is employed as farm laborers, except unpaid and farm foremen; and farm laborers, unpaid family workers. Also, there is a much larger proportion of Negro females in the rural-farm population employed as private household workers than among white females.

INCOME

There is little valid data pertaining to the income of rural people as compared to other groups. This results, in part, from the difficulty of reducing farm income to monetary terms. Since a significant part of the income of a farm is consumed by the farm family itself without entering the open market, dollar incomes are not always exact indications of the level of living of a farm family. Nevertheless, the Census does make available data relative to income which allows for a comparison of farm income to the income of other groups in the society. These data show that 31.1 per cent of the families and unrelated individuals in the state in 1950 had incomes in 1949 of less than $1,000.[6] Still further, 22.8 per cent had incomes in 1949 of $1,000 to $1,999; 16.3 per cent had incomes of $2,000 to $2,999; 11.6 per cent had $3,000 to $3,999; 7.1 per cent received $4,000 to $4,999; 4.2 per cent received $5,000 to $5,999; 2.4 per cent had $6,000 to $6,999; and 4.6 per cent received $7,000 and over. These figures are much more meaningful if they are considered by race and residence. Table X presents the income in 1949 of families and unrelated individuals by race and residence in 1950. Approximately one-fifth (22.7 per cent) of the whites had incomes of less than $1,000 per year as compared to almost one-half (49.1 per cent) of the nonwhites. In the urban population 17.6 per cent of the whites and 41.6 per cent of the nonwhites fell into this category. Similar figures for the rural-nonfarm population was 27.3 per cent for whites and 55.5 per cent for nonwhites. In the rural-farm population, larger proportions of both whites and nonwhites had incomes under $1,000 than in the urban and nonfarm population. About one-third (35.5 per cent) of the whites and approximately two-thirds (63.8 per cent) of the nonwhites in the farm population had incomes in 1949 of less than $1,000.

Data on the median income of persons 14 years of age and over (who had incomes in 1949) by sex, race, and residence are presented in Table XI. The highest median incomes are found among urban white males.

TABLE X.—Income in 1949 of Families and Unrelated Individuals, by Race and Residence, Louisiana, 1950

Income	Percentage Distribution							
	Total		Urban		Rural-Nonfarm		Rural-Farm	
	White	Nonwhite	White	Nonwhite	White	Nonwhite	White	Nonwhite
Less than 1,000	22.7	49.1	17.6	41.6	27.3	55.5	35.5	63.8
1,000 to 1,999	19.0	31.2	14.9	32.5	23.1	31.1	29.1	27.6
2,000 to 2,999	17.9	13.1	18.0	17.0	18.6	9.6	15.7	5.9
3,000 to 3,999	15.1	4.1	17.2	5.7	14.2	2.4	8.5	1.6
4,000 to 4,999	9.7	1.3	11.7	1.7	7.7	0.7	4.7	0.5
5,000 to 5,999	5.8	0.6	7.5	0.7	3.7	0.3	2.3	0.3
6,000 to 6,999	3.3	0.3	4.4	0.4	2.0	0.2	1.3	0.1
7,000 and over	6.5	0.3	8.7	0.4	3.4	0.2	2.9	0.2

Source: United States Census of Population, 1950, *Louisiana,* "General Characteristics," Vol. II, Part 18, Tables 32 and 32a.

---

[6] A family, as defined in the 1950 Census, is a group of two or more persons related by blood, marriage, or adoption and living together; all such persons are regarded as members of one family. Unrelated individuals are persons 14 years of age and over (other than inmates of institutions) who are not living with any relatives.

TABLE XI.—Median Income by Race, Sex, and Residence, Louisiana, 1949

	Total 14 and Over			Total Without Income			Median Income		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
				THE STATE					
White	1,287,160	627,715	659,445	471,505	74,940	396,565	1,767	2,228	920
Negro	581,795	272,745	309,050	183,270	37,935	145,335	773	997	512
Other Races	2,635	1,570	1,065	1,045	230	815	1,010	1,067	.
Total Population	1,871,590	902,030	969,560	655,820	113,105	542,715	1,259	1,715	721
				URBAN AND RURAL-NONFARM					
White	1,062,275	509,855	552,420	371,000	53,790	317,210	1,936	2,460	960
Negro	442,970	202,450	240,520	128,175	25,100	103,075	831	1,184	554
Other Races	2,355	1,425	930	920	200	720	1,085	1,131	...
Total Population	1,507,600	713,730	793,870	500,095	79,090	421,005	1,411	1,962	759
				NEW ORLEANS					
White	303,195	141,540	161,655	98,610	14,415	84,195	2,061	2,603	1,223
Negro	129,520	58,140	71,380	40,065	7,880	32,185	986	1,469	694
Other Races	565	360	205	160	35	125	...	.	.
Total Population	433,280	200,040	233,240	138,835	22,330	116,505	1,639	2,163	918
				RURAL-FARM					
White	224,885	117,860	107,025	100,505	21,150	79,355	1,037	1,221	653
Negro	138,825	70,295	68,530	55,095	12,835	42,260	566	684	368
Other Races	280	145	135	125	30	95	.	.	
Total Population	363,990	188,300	175,690	155,725	34,015	121,710	809	925	464

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 87.

In New Orleans, white males had average incomes of $2,603 in 1949. In the urban and rural-nonfarm populations combined, white males received an average income of $2,400. In the state generally, white males had median incomes of $2,228. The average income of the white males in the rural-farm population was only about half ($1,221) that received by their urban and nonfarm counterparts.

The lowest median incomes among males was the $684 received by rural-farm Negroes. It is interesting to note that Negroes in New Orleans had a higher average income than white males in the rural-farm population. The median income of Negroes in the urban and nonfarm population also almost equaled that of white males in the rural-farm population.

As is expected, women generally have a much lower median income than men. The average income of white women in the state in 1949 was $920 as compared to $2,228 for white men. Comparable figures for Negroes are $512 and $997. Therefore the differential in income is much greater between white men and women than between Negro men and women. The lowest median income among women was the $368 recorded for Negro females in the rural-farm population. The highest average income among women was found in the white population of New Orleans. White women in that city had a median income of $1,223, which was approximately the same as that received by white men in the rural-farm population.

These data clearly indicate that whites have higher incomes than nonwhites, and that urban and rural-nonfarm people have higher incomes than rural-farm families. In fact, the highest incomes are found among whites in the urban population and the lowest incomes among nonwhites in the rural-farm population.

TRENDS

The population of Louisiana has been increasing at a rapid rate since 1900. At that time the state had 1,381,625 persons in its population as compared to 2,683,516 people at mid-century. The growth trends in the population are plotted in Figure 20, which shows patterns of change of the residential components. Between 1900 and 1910, the population increased rapidly. It actually increased 19.9 per cent over the preceding census. The rate of increase of the Twentieth Century was the slowest from 1910 to 1920, during which time the increase amounted to only 8.6 per cent. From 1920 to the present, the rate of growth has been high. Between 1920 and 1930, the increase amounted to 16.9 per cent; between 1930 and 1940, the population grew 12.5 per cent; and between 1940 and

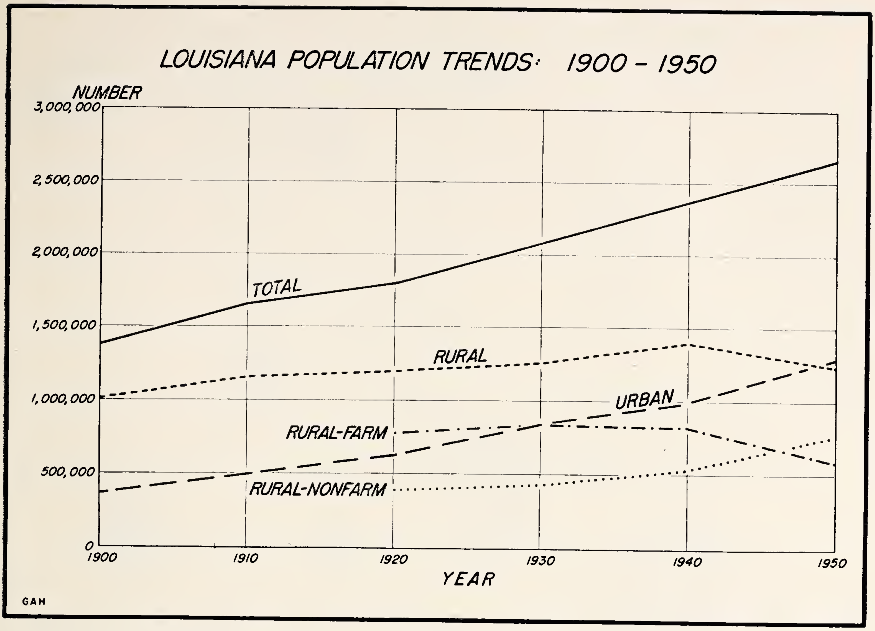


FIGURE 20.—Louisiana Population Trends: 1900 to 1950, by Residence. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Tables 1, 13.)

1950 the increase amounted to 13.5 per cent. Since 1900 the population has increased a total of 94.2 per cent.

Although the growth of the total population of the state has been rapid and consistent, its residential components have not followed a similar growth pattern. Since 1900 the population has been differentiated into rural and urban categories, and since 1920 the rural category has been further subdivided into rural-nonfarm and rural-farm classifications. A study of Figure 20 shows that the increase which has been recorded by the total population results primarily from growth in urban and rural-nonfarm areas. These two residential areas had a pattern of population growth which roughly paralleled that of the state generally. The rural-farm population, on the other hand, had a very different growth pattern. In fact, since 1940, a very significant decrease has occurred in the absolute and relative numbers of farm people. Between 1940 and 1950, this decrease amounted to 282,247 persons, or 33.2 per cent. (See Table XII.) At the same time the urban population increased 39.1 per cent and the rural-nonfarm population grew 41.0 per cent. These changes have made urban people numerically dominant. In 1950, more than half (54.8 per cent) of the state's population lived in cities, and for the first time in history, Louisiana had more urban than rural people.

TABLE XII.—Relative and Absolute Population Changes in Louisiana, by Race and Residence, 1940-1950
(Old Census Definition)

Louisiana	1940	1950	Absolute Change	Percentage Change
Total	2,363,880	2,683,516	319,636	13.5
Urban	980,439	1,363,789	383,350	39.1
Rural-Farm	850,382	568,135	−282,247	−33.2
Rural-Nonfarm	533,059	751,592	218,533	41.0
White	1,511,739	1,796,683	284,944	18.8
Urban	665,464	940,878	275,414	41.4
Rural-Farm	469,446	333,134	−136,312	−29.0
Rural-Nonfarm	376,829	522,671	145,842	38.7
Nonwhite	852,141	886,833	34,692	4.1
Urban	314,975	422,911	107,936	34.3
Rural-Farm	380,936	235,001	−145,935	−38.3
Rural-Nonfarm	156,230	228,921	72,691	46.5

Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Tables 5 and 50.

The growth which has characterized the total population has not occurred in all of the individual parishes. Figure 21 shows the change in the population between 1940 and 1950 by parishes. This figure shows that population increase during this decade took place in only 34 parishes. In relative proportions, the greatest increase occurred in Jefferson, East Baton Rouge, Calcasieu, St. Bernard, Lafayette, Rapides, Ouachita, Bossier, and Terrebonne parishes. Jefferson Parish more than doubled its 1940 population, and East Baton Rouge and Calcasieu increased by more than one half. All of the remainder in the above group increased by 20 per cent or more. From a geographical standpoint, most of the parishes which underwent considerable population growth are located in the southern half of the state. Also, the parishes which are the most urban or which are in the process of urbanizing showed high rates of growth during 1940 and 1950.

Few people realize that in 30 parishes of the state actual population declines took place between 1940 and 1950. Furthermore, in some of these parishes the amount of decrease was highly significant. De Soto, Red River, Bienville, Catahoula, Tensas, Caldwell, Claiborne, East Carroll, Jackson, West Feliciana, Sabine, Grant, and Cameron parishes lost 10 per cent or more of their populations. The greatest losses were recorded in De Soto, Red River, and Bienville parishes, which lost more than one-fifth of their populations during the 1940 to 1950 decade. Parishes which lost population are located principally in the Red River Delta Area, the North Louisiana Uplands, the North Central Louisiana Cut-Over Area, the Mississippi Delta Area, and the West Central Cut-Over Area. For the

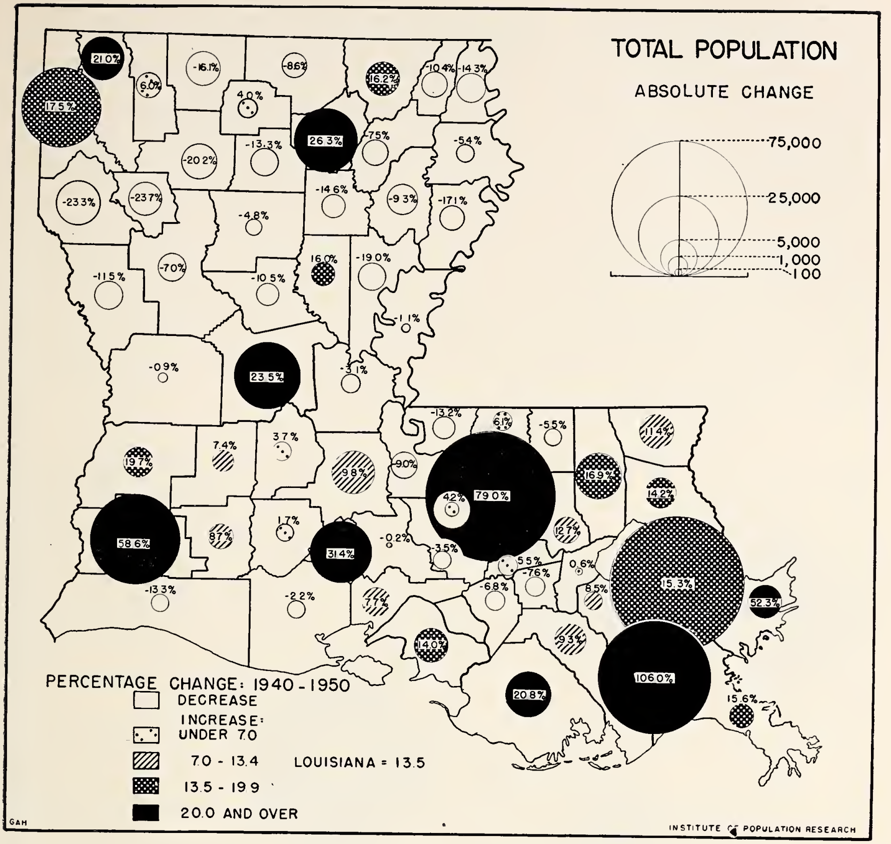


FIGURE 21.—Population Change, Louisiana, 1940 to 1950, by Parishes. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 5.)

most part, the rural parishes are the ones which lost population during this decade.

In considering population change by race in the state during 1940 and 1950, one finds that the white people grew in relative numbers considerably more rapidly than did the Negroes. In fact, the white population increased by 18.8 per cent as compared to only 3.9 per cent for Negroes. Therefore, whites were increasing faster than the state population as a whole (13.5 per cent) and Negroes were increasing much less rapidly. Figures 22 and 23 show the population change between 1940 and 1950 by parishes for whites and Negroes.

The data show that the white population of 39 parishes increased between 1940 and 1950. The greatest relative increases occurred in Jefferson, East Baton Rouge, Calcasieu, St. Bernard, Bossier, Morehouse, Lafayette, Ouachita, Rapides, Caddo, and Plaquemines parishes. In each of these parishes the white population increased by more than one-fourth. The greatest relative increases took place in Jefferson, which more than doubled its white population, and in East Baton Rouge, which almost doubled its whites also. The white population of Calcasieu, St. Bernard, and Bossier parishes increased by more than 50 per cent between 1940 and 1950.

The greatest relative losses in white population occurred in Red River, Bienville, Catahoula, Jackson, Caldwell, Sabine, and Cameron parishes. Each of these areas recorded a decline of more than 10 per cent in their white populations. Red River and Bienville parishes lost more than one-fifth of their white people. Altogether, 25 of the parishes recorded decreases in their white population.

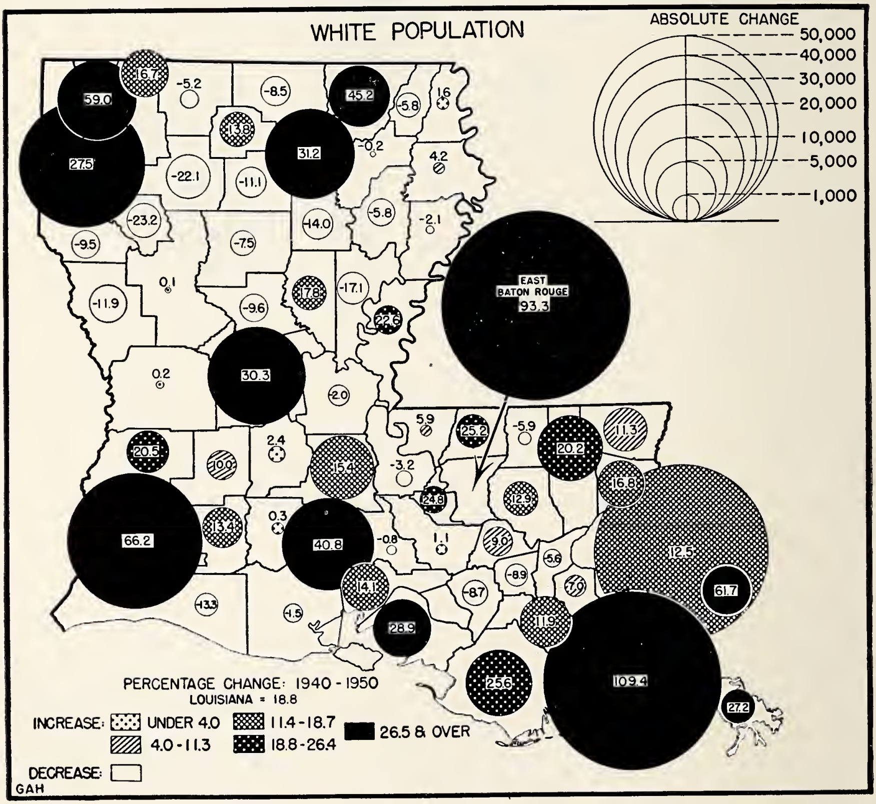


FIGURE 22.—Population Change, White Population, Louisiana, 1940 to 1950, by Parishes. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 41; and United States Census, 1940, "Characteristics of the Population," Vol. II, Part 3, Louisiana, Table 21.)

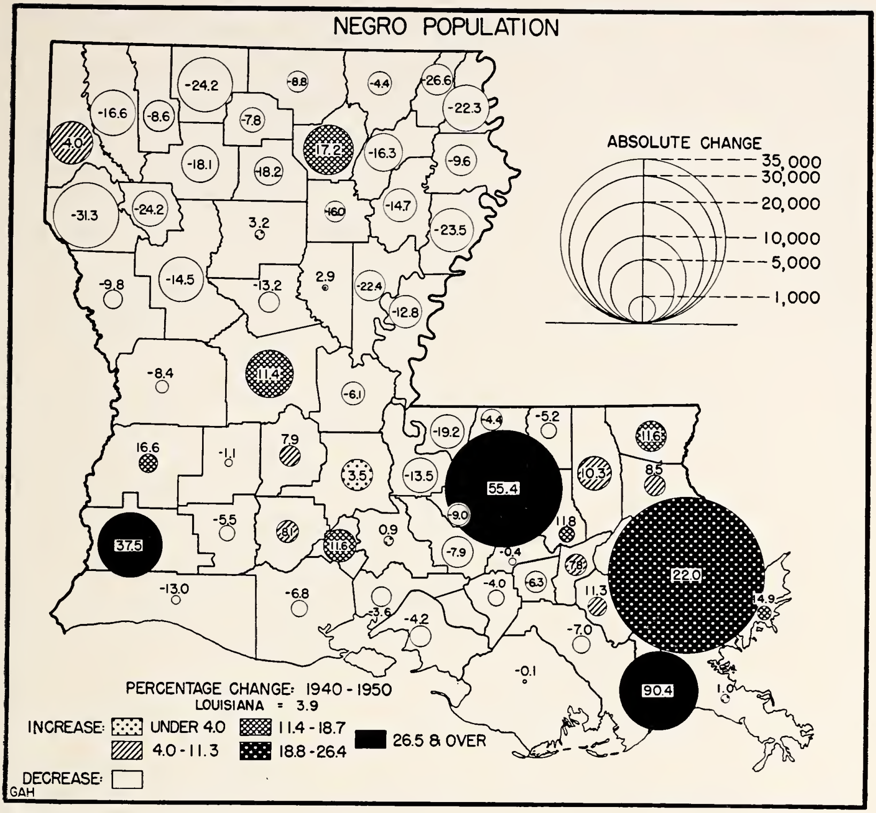


FIGURE 23.—Population Change, Negro Population, Louisiana, 1940 to 1950, by Parishes. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 42; and United States Census, 1940, "Characteristics of the Population," Vol. II, Part 3, Louisiana, Table 21.)

The areas which experienced the greatest gains in their white populations are those which are urban or in the process of urbanization. These parishes recording the greatest increases are located, for the most part, in the southern half of the state. The areas losing white population generally are the rural parishes. The areas experiencing significant losses of whites are the West Central Cut-Over Area; the North Louisiana Uplands, except Ouachita and Lincoln parishes; the North Central Louisiana Cut-Over Area, except LaSalle Parish; the Mississippi Delta Area, except Concordia, Madison, East Carroll, and Morehouse parishes; the West Central Cut-Over Area; and Red River Parish.

The pattern of change for the Negro population of the different parishes is somewhat different from that of the white. (Compare Figures 22 and 23.) One very noticeable difference is that only a comparatively few parishes recorded a gain in their Negro populations between 1940 and 1950. In fact, gains in the number of Negroes occurred in only 23 parishes and in most of these the increases were relatively small. Jefferson, East Baton Rouge, and Calcasieu parishes made large relative gains in the number of Negroes, increasing by more than one-third. Negroes in Jefferson Parish almost doubled in number, increasing 70.4 per cent. In East Baton Rouge, they increased by 55.4 per cent. Increases of significant proportions were also recorded in Orleans, St. Bernard, Washington, Livingston, Lafayette, Rapides, and Ouachita parishes. All of these parishes recorded increases of 11.4 per cent or above in their Negro population. It should be noted that most of these areas gaining in the number of Negroes are urban and are located in the southern half of the state.

The dominant pattern among the Negro populations of the different parishes has been a decrease. In fact, in 41 parishes the number of Negroes declined between 1940 and 1950. A consistent pattern of decline characterized the Negro population of practically all of the parishes in the northern half of the state. Only Caddo, Ouachita, Rapides, Winn, and LaSalle parishes recorded increases, and they were insignificantly small in the latter two parishes. On the other hand, some parishes in this area lost tremendously of their Negro populations. De Soto Parish lost nearly one-third (31.3 per cent) of its Negroes between 1940 and 1950. Also West Carroll, East Carroll, Tensas, Catahoula, Claiborne, and Red River parishes lost more than one-fifth of their Negro populations during this decade. For the most part, the more rural parishes have undergone the largest declines in the number of Negroes, and all rural parishes have lost in Negro population generally.

A study of population change among the rural-farm people reveals a very consistent pattern of decline. Figures 24 and 25 show the trends in the rural-farm population by parishes between 1940 and 1950 for whites and nonwhites. The total white farm population declined 29 per cent during that decade and the nonwhite farm population decreased 38.3 per cent during the same period. The greatest decline in white farm people took place in Terrebonne, Iberville, West Feliciana, Jackson, and Caddo parishes. In each of these, the white farm population declined by roughly one-half (more than 47.0 per cent) between 1940 and 1950. Other parishes which experienced great losses of white farm people (more than 38.0 per cent) were Lafourche, Iberia, Calcasieu, Natchitoches, Ouachita, Union, Claiborne, Webster, and Bienville.

The parishes which lost least of their white farm people between 1940 and 1950 were located in the West Florida Parishes. St. Tammany, Tangipahoa, Livingston, East Baton Rouge, and West Baton Rouge parishes

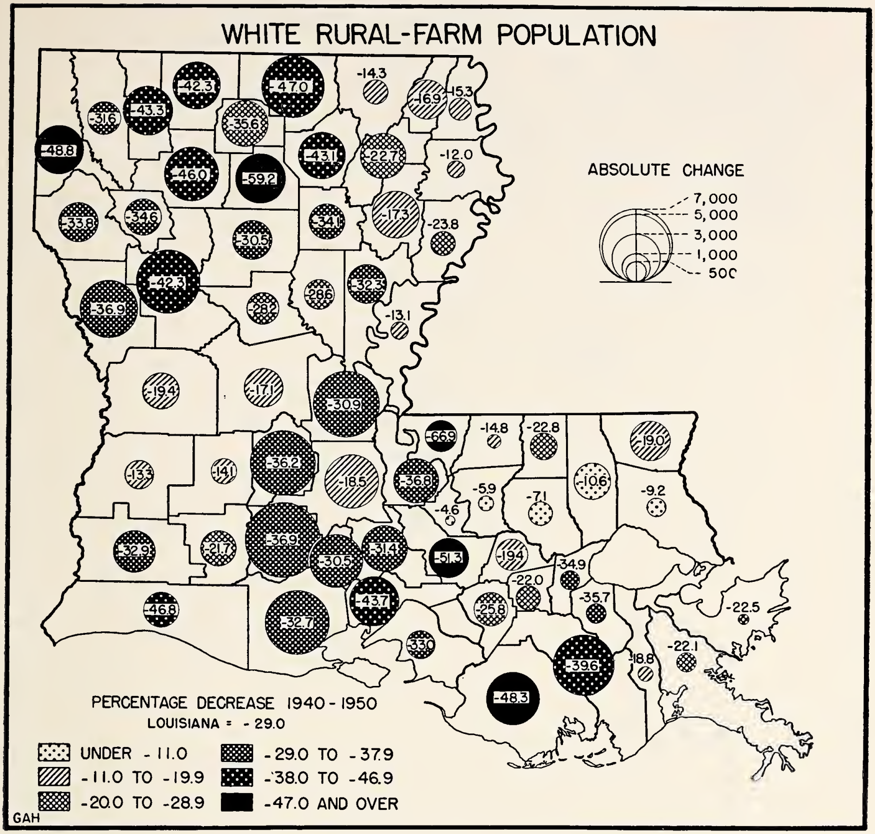


FIGURE 24.—Population Change, White Rural-Farm Population, Louisiana, 1940 to 1950, by Parishes. (Source: United States Census, 1950, *Louisiana*, "Characteristics of the Population," Vol. II, Part 18, Table 49; and United States Census, 1940, "Characteristics of the Population," Vol. II, Part 3, Louisiana, Table 27.)

lost less than 11.0 per cent of their white farm people. Outside of this area, relatively small declines in the number of white farm people were recorded in the Mississippi Delta Area and the West Central Cut-Over Area. In the remainder of the state, losses of approximately 3 out of every 10 white farmers occurred between 1940 and 1950.

Seven parishes lost less than one-fifth of their nonwhite farm population. These underwent the smallest relative declines. They were Washington, St. Helena, St. James, Assumption, St. Landry, Evangeline and Allen parishes. All of these parishes are located in the southern half of the state. Strangely enough, St. Tammany Parish actually recorded an increase in its nonwhite farm population. This is the only increase which occurred in the farm population of either whites or nonwhites. However, the number of nonwhites in the farm population of this parish is not large.

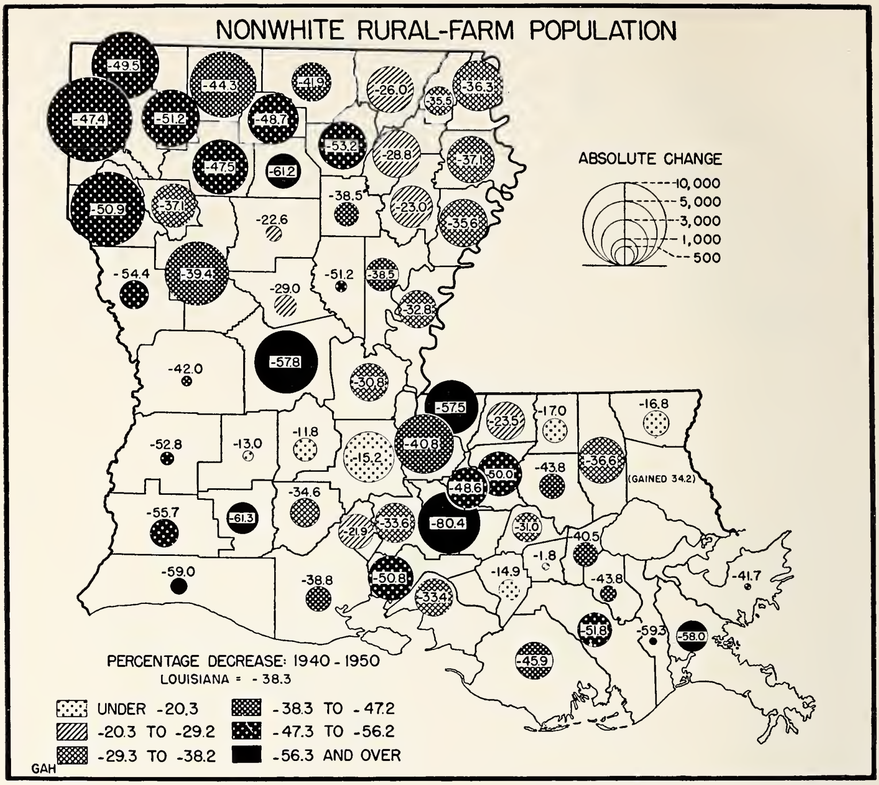


FIGURE 25.—Population Change, Nonwhite Rural-Farm Population, Louisiana, 1940 to 1950, by Parishes. (Source: United States Census, 1950, *Louisiana,* "Characteristics of the Population," Vol. II, Part 18, Table 49a; and United States Census, 1940, "Characteristics of the Population," Vol. II, Part 3, Louisiana, Table 27.)

Summarizing, the data relative to population change generally show a rapidly increasing population in the state. However, the increase does not characterize all segments of the population. Rather, it stems from rapid growth in the urban and rural-nonfarm population. The rural-farm population has undergone considerable decline in recent decades. Furthermore, the population growth has not occurred equally in all of the parishes. Many of them have actually undergone very large population decreases at the same time that the state as a whole was experiencing rapid growth. For the most part, the decline in population has been in the parishes which are predominantly rural. The nonwhite population has not been increasing with the same rapidity as the white. In most parishes, tremendous relative and absolute declines in the number of nonwhite farm people have characterized the decade betwen 1940 and 1950. In many sections, there has been a veritable exodus of nonwhite farm people. A similar circumstance exists among the white farm people but to a considerably lesser extent.

SUMMARY AND CONCLUSIONS

1. In 1950, the population of Louisiana numbered 2,683,516 persons. These people are concentrated in certain areas of the state while other areas are very sparsely populated. Heavy concentrations of rural people generally center around the urban places. This is especially true of the larger cities.

2. The majority of the people of the state live in urban places. In 1950, 54.8 per cent of the population were residents of cities. Of the remaining population, 24.0 per cent had rural-nonfarm residence and 21.2 per cent lived on farms.

3. In 1950, the median age of the population was 26.7 years. The median age of the rural-farm population was 21.6 years as compared to 24.9 years for the rural-nonfarm and 28.7 years for the urban population. The rural-farm population is characterized by an excessively large proportion of children and a proportionately small number of persons in the productive years of life. The urban population has a relatively large number of persons in the productive years and a comparatively smaller proportion of children. The age structure of the rural-nonfarm population more closely approximates that of the rural-farm than the urban population. The increase in the birth rate since the Second World War is clearly evident in the age structure of the population. The state is confronted with a situation in which both children and old persons are increasing proportionately, which means that the burden of caring for persons in the dependent ages will be considerably heavier in the immediate future. This is a fact of great importance to the state from a social and economic standpoint.

4. The population of Louisiana is characterized by a numerical dominance of females. In 1950, the sex ratio was 96.7. The urban population had a sex ratio of 92; the rural-nonfarm had 100.2; and the rural-farm population had 105.6 males for each 100 females. The sex ratio of the white population was 98.6 as compared to 92.8 for Negroes. Also, Negroes had lower sex ratios than whites in each of the residential areas.

5. Louisiana, in 1950, had the third largest proportion of Negroes in its population among the states of the nation. Only Mississippi and South Carolina have proportionately more Negroes than does Louisiana. At mid-century, about one-third (32.9 per cent) of the population of Louisiana was Negro. An analysis of the distribution of Negroes within the state clearly shows that they are heavily concentrated in certain areas and are relatively few in others. For the most part, parishes with very

large Negro populations are located in the Mississippi River Delta Area and the Red River Delta Area. Most of the parishes with small proportions of Negroes in their populations are located in the southern section of the state and a significant number of them border on the Gulf of Mexico. Negroes made up 30.4 per cent of the urban population in 1950. They constituted 31.1 per cent of the rural-nonfarm population and 41.3 per cent of the rural-farm population. A review of trends in the composition of the population by race since 1900 clearly shows that Negroes are declining in relative importance. In 1900, Negroes constituted 47.1 per cent of the people as compared to only 32.9 per cent in 1950. This decrease in the relative importance of Negroes has characterized each of the residential areas.

6. Foreign-born persons numbered 28,884 individuals in 1950 and accounted for 1.6 per cent of the white population. These people are heavily concentrated in the cities of the state. Less than one out of ten was located in the rural-farm population. Parishes with the largest numbers of foreign-born persons are Orleans, Caddo, East Baton Rouge, Jefferson, and Tangipahoa. Italy has contributed the largest number of persons to the foreign-born population of Louisiana. In 1950, about one-fourth of the foreign-born persons in the state were from Italy. Persons born in Germany constituted the second largest foreign-born group, and people from England and Wales ranked as the third most important. However, among farm residents, persons born in Hungary made up the third most important foreign-born population. The data show that since 1900, there has been a consistent and steady decline in the relative significance of foreign-born persons in the population of Louisiana.

7. At mid-century, the educational attainment of the people 25 years of age and over in Louisiana was still below the national average. Within the state, white persons have greater educational attainment than Negroes, and urban people have more schooling than rural persons. Women have a higher educational status than men. The data show that 9.4 per cent of the population 25 years of age in 1950 had received no schooling, 53.4 per cent had attended elementary school, 26.7 per cent had attended high school, and 10.5 per cent had been to college. The urban population had the lowest proportion with no schooling and the rural-farm population recorded the largest proportion without formal schooling. Negroes had much larger proportions than whites without schooling in each of the residential areas. Educational attainment is particularly low in certain areas of the state. Low educational attainment among the adult farm population characterizes the Sugar Bowl Area, the South Central Mixed Farming Area, the Southwest Rice Area, the Red River Delta Area, and the Mississippi Delta Area. In 1950, five parishes had median years of

schooling completed of less than 3.5 years among rural-farm persons 25 years of age and over. These were St. Landry, Lafayette, St. Martin, Iberia, and St. Mary parishes. The decade between 1940 and 1950, however, witnessed considerable improvement in the educational status of Louisiana's adults.

8. The data on marital status of the population 14 years of age and over show that males live in a married state to a greater extent than females. This same situation prevails in the urban population. However, in the rural-nonfarm and rural-farm populations, females are married in greater proportions than are men. Males live in a widowed and divorced status to a much lesser extent than females in each of the residential areas. Also, a larger proportion of males than females are single in each of the residential areas. Among males, nonwhites have a larger proportion single and widowed and divorced, and a smaller proportion in the married category. This observation is true of each of the residential areas. Among females, nonwhites also have a higher proportion single and widowed and divorced, and a smaller proportion in the married category. The only exception is that, in the rural-nonfarm population, nonwhite females have a smaller proportion married than whites.

9. An analysis of occupational status in 1950 reveals that farmers and farm managers constituted 9.8 per cent and that farm laborers and foremen made up 6.5 per cent of the experienced civilian labor force of the state. In studying the composition of the experienced civilian labor force by residential areas, one finds that persons in the rural-farm population are engaged in considerable numbers in occupations other than those connected with agriculture. About one-fourth are employed in occupations not directly connected with farming. These are operatives and kindred workers; craftsmen, foremen, and kindred workers; and laborers, except farm and mine. The composition of the labor force of whites and Negroes in the rural-farm population shows a considerable degree of similarity. The largest proportions of both races are classified as farmers and farm managers. The principal distinction between the occupational statuses of whites and Negroes on farms is that a much larger proportion of the latter are employed as farm laborers, except unpaid and farm foremen; and farm laborers, unpaid family workers. Also, a much larger proportion of Negro females are employed as private household workers than among white females. In the urban and rural-nonfarm populations, Negroes tend to have much larger proportions than whites classified as private household workers and laborers of all types.

10. The data relative to income clearly show that whites have higher incomes than nonwhites and that urban and rural-nonfarm people have higher incomes than rural-farm families. In fact, the highest incomes are

found among whites in the urban population and the lowest incomes among nonwhites in the rural-farm population.

11. The population of Louisiana has been increasing at a rapid rate since 1900. However, its residential components have not followed a similar growth pattern. The increase which has been recorded for the state generally has resulted primarily from growth in the urban and rural-nonfarm areas. The rural-farm population, on the other hand, has had a very different growth pattern. Since 1940, the rural-farm population has undergone a significant decrease in absolute and relative numbers, amounting to 282,247 persons or 33.2 per cent. During the same period, the urban population increased 39.1 per cent and the rural-nonfarm population grew 41.0 per cent.

12. The growth which characterized the total population has not occurred in all of the individual parishes. In fact, population increases between 1940 and 1950 took place in only 34 parishes. From a geographical standpoint, most of the parishes which underwent considerable population growth are located in the southern half of the state. Also, the parishes which are the most urban or which are in the process of urbanizing showed the highest rates of growth during 1940 to 1950. The majority of the 30 parishes which lost population during this decade are located in the Red River Delta Area, the North Louisiana Upland Area, the North Central Louisiana Cut-Over Area, the Mississippi Delta Area, and the West Central Cut-Over Area. For the most part, the rural parishes are the ones which lost population during this decade.

13. The white population experienced gains between 1940 and 1950 in 39 parishes. The greatest gains were recorded in the parishes which are urban or in the process of urbanization. The areas losing white population are generally rural in nature. The Negro population showed a greater tendency to decline in the individual parishes than did the white. In fact, increases in the number of Negroes occurred in only 23 parishes and in most of these the increases were relatively small. Most of the parishes recording gains in Negro population are urban and are located in the southern half of the state.

14. A study of population change among the rural-farm people reveals a very consistent pattern of decline. The white farm population declined 29.0 per cent and the nonwhite farm population decreased 38.3 per cent during 1940 to 1950. In fact, the white population on farms in every parish declined between 1940 and 1950. In five parishes the white farm population declined by approximately one-half. The nonwhite farm population of every parish except one (St. Tammany) also underwent decreases during this decade. Furthermore, in seven parishes, more than half of the Negro farm population was lost between 1940 and 1950.

630.7
L93b
c.2

Population Behavior Of Plant Parasitic Nematodes In Soil Fumigation Experiments

By John P. Hollis and Max J. Fielding

Photomicrograph of plant parasitic nematodes *Tylenchorhynchus martini* Fielding 1956 feeding on a rice root.

Bulletin No. 515 **May 1958**

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

CONTENTS

Page
INTRODUCTION 3
PARTIAL REVIEW OF LITERATURE 3
EXPERIMENTAL METHODS 6
  Sampling Procedures 6
  Enumeration of Nematodes 7
  Preliminary Evaluation of Sampling Methods 8
  Evaluation of Fumigants 9
EXPERIMENTAL RESULTS 9
  Effectiveness of Fumigation 10
  Statistical Evaluation of Data 10
  Analysis of Data on Pure and Mixed Populations of Pratylenchus, Trichodorus and Tylenchorhynchus Species 12
  Population Trends of Species of Pratylenchus, Trichodorus and Tylenchorhynchus 13
  Population Trends of Species of Tylenchus and Psilenchus 14
  Correlation of Intraseasonal Fluctuations in Populations of Tylenchorhynchus Species with Rainfall and Flood Periods 15
  Generic Differences in the Population Recovery of Nematodes Following Fumigation 18
  Relation of Fumigant Vapor Pressure to the Recovery of Nematode Populations 20
  Comparative Efficiency of Fumigants 21
DISCUSSION 22
SUMMARY 27
LITERATURE CITED 28

COVER PICTURE

Two nematodes have forced their heads into the growing region of a rice root and are sucking contents of the cell. They perform these activities with the aid of a stylet or spear (hollow tube located in the head, which can be moved forward and backward by means of attached muscles). In this way, nematodes may inject poisonous substances, destroy cells or provide wounds through which other microorganisms can gain entrance into plants.

POPULATION BEHAVIOR OF PLANT PARASITIC NEMATODES IN SOIL FUMIGATION EXPERIMENTS

JOHN P. HOLLIS[1] and MAX J. FIELDING[2]

INTRODUCTION

The occurrence and activities of common plant parasitic nematodes on important crop plants in Louisiana were investigated in 21 soil fumigation experiments in 1955-56. The effects of fumigation on crop yields have been reported (4, 11, 23, 31, 32), and the present paper is concerned solely with an analysis of the nematode data. Results of this investigation which merit emphasis include (1) generic differences in population trends and reaction to fumigants and (2) relations between fumigant vapor pressure and population recovery of nematodes following fumigation.

Current knowledge of fumigant-nematode interactions is characterized by a shortage of critical data and the absence of unifying theories of fumigant mechanisms and nematode reactions. This work provides a rationale for the evaluation of fumigation results based on fumigant vapor pressure and the reactions of different genera of plant parasitic nematodes.

PARTIAL REVIEW OF LITERATURE

One of the most evident characteristics of nematode populations in the soil is their tendency to fluctuate. Micoletzky (19) was the first worker to present evidence of seasonal fluctuations in nematode numbers and species. He found that numbers were highest in the fall and lowest in the late winter (February), rising again in the spring. The seasonal trends were attributed to changes in temperature, moisture, plant growth and decomposition. The number of nematode species paralleled the number of nematodes, and different groups of species were found to respond to the fall and spring maxima. Seidenschwarz (29) studied seasonal variations in nematode fauna and concluded that marked fluctuations in numbers occurred. He found the greatest number in August and the fewest from

---

[1] Assistant professor of Plant Pathology, Department of Plant Pathology, Louisiana State University, Baton Rouge, Louisiana.

[2] Formerly Associate Nematologist, Horticultural Crops Research Branch, U. S. Department of Agriculture, Baton Rouge, Louisiana; now Research Scientist, E. I. duPont de Nemours, Wilmington, Delaware.

November through January. He observed that different species attained maximum populations at different times of the year. Overgaard Nielsen (24) questioned the occurrence of seasonal fluctuations, citing as evidence his own results and those of Franz (1942) and Stöckli (1943).

Recently, several workers have demonstrated significant seasonal fluctuations in populations of *Pratylenchus* species: Graham (9), *Pratylenchus zeae* Graham 1951 in tobacco and corn; Goheen and Williams (8) *Pratylenchus* sp. in cultivated brambles; and Riggs, Slack and Fulton (27), *Pratylenchus coffeae* Zimmerman 1898 in strawberries. Sasser and Nusbaum (28) studied seasonal fluctuations in root knot nematode populations composed of three species of *Meloidogyne* in two-year tobacco rotation plots with cotton and corn. Wehunt (30) related seasonal population trends of *Pratylenchus* sp. and *Tylenchorhynchus* sp. to the growth of white Dutch clover (*Trifolium repens* L.). Maximum clover yields and highest nematode populations occurred from January to June.

Soil fumigation for control of nematodes and other organisms causing root disorders is an established practice in high-value crops such as tobacco, sugar beets and certain vegetables. The materials most widely used are common halogenated hydrocarbons characterized, as follows, by their principal ingredients and trade names: (1) methyl bromide (Dowfume MC-2), (2) 1,3-dichloropropene-1,2-dichloropropane (D-D mixture), (3) 1,2-dibromoethane (Dowfume W-85) and (4) 1,2-dibromo-3-chloropropane (Nemagon). All of these materials have been tested for their effectiveness in reducing nematode populations and in improving yields in the principal crops where nematodes are suspected of causing damage. An extensive literature treating their effects on the soil microfauna and microflora has been summarized by Newhall (21). The present review will be confined to more recent papers dealing with the comparative effects of soil fumigants on nematodes.

As far as the authors are aware, there have been no reports of generic or specific differences in resistance of plant parasitic nematodes to soil fumigants. There have been frequent reports of differences in the rate of build-up of soil populations of nematodes following fumigation, and there is general agreement that these differences are caused by a variety of factors, but Perry (26) has emphasized that species differences are probably one of the most important. He reported that populations of the stubby root nematode (*Trichodorus* sp.) increased very rapidly in fumigated plots whereas the sting nematode (*Belonolaimus gracilis* Steiner 1949) increased much more slowly (25, 26). Several other species, including *Dolichodorus heterocephalus* Cobb 1944, were intermediate in their rates of population recovery following fumigation but an abnormal build-up in fumigated plots (where populations soon exceeded those in control plots) was manifested only by the stubby root nematode.

McBeth (18) stated that recent experience in Florida, comparing D-D mixture with Nemagon, has shown that the latter is more effective in suppressing population build-up of the stubby root nematode after fumigation. Similar differential effects of fumigant action have been observed with other nematodes. Graham and Holdeman (10) found that high applications of Dowfume W-40 (a diluted preparation of 1,2-dibromoethane with solvent) suppressed populations of sting nematode more completely than meadow nematodes (*Pratylenchus* spp.). In an additional test with less Dowfume W-40 applied, all sting nematodes but only one-half the meadow nematodes were killed. Holdeman (12), in three years of field trials conducted in deep sandy soil in South Carolina, found Dowfume W-85 and Nemagon more effective than D-D mixture against sting nematodes. Nusbaum (22) compared the action of D-D mixture and Dowfume W-85 against several nematode species on 16 tobacco farms in North Carolina. Dowfume W-85 was more effective than D-D mixture against the tobacco stunt nematode (*Tylenchorhynchus claytoni* Steiner 1937) but less effective than the latter against meadow nematodes. Anderson (2) compared initial kills of *Rotylenchulus reniformis* Linford and Oliveira 1940 by D-D mixture, Dowfume W-85 and Nemagon, and found them effective in that order.

Consistent results have been obtained by various workers in comparing the effectiveness of these fumigants against different cyst nematodes. Allen and Raski (1) studied the effects of D-D mixture and ethylene dibromide mixture (a standard preparation of 1, 2-dibromoethane) against sugar beet cyst nematode (*Heterodera schachtii* Schmidt 1871) and root knot nematodes in light and heavy soils. The importance of soil texture in relation to fumigant effectiveness was shown when D-D mixture was found ineffective against the sugar beet nematode in soils of high clay and organic matter content. This was believed due to failure of the chemical to diffuse through these soils. D-D mixture and ethylene dibromide mixture were equally effective against root knot nematode larvae in a sandy soil, but the latter failed to kill encysted sugar beet nematode eggs. Parallel results were obtained in field fumigation studies on Long Island by Lear et al (16) with the golden nematode of potato (*Heterodera rostochiensis* Wollenweber 1923). D-D mixture was effective whereas Dowfume W-40 in comparable dosages was ineffective against the nematode. Another cyst nematode, *Heterodera glycines* Ichinohe 1952 on soybeans, was investigated recently in fumigation tests by Endo and Sasser (6). D-D mixture was more effective than Dowfume W-85 or Nemagon in the reduction of numbers of viable larvae and white cysts.

EXPERIMENTAL METHODS

The experiments were conducted in 7 crop regions in northern Louisiana and 4 crop regions in southern Louisiana (Table 1). The design of experiments was a randomized block or Latin square, comprising usually 4 treatments (3 fumigant applications and a control), each replicated 4 times. Sizes of plots were determined by the agronomic requirements for obtaining accurate yield data.

Four fumigant materials[3] were used in the experiments: D-D mixture, Dowfume W-85, Nemagon and Dowfume MC-2.

Fumigants, with the exception of Dowfume MC-2, were injected into the soil with MacLean hand applicators. Injections were made on a grid pattern formed by marking each plot lengthwise and crosswise with a row marker. The marker rows were spaced 1 foot apart and injections along the rows were at 1-foot intervals. Injections were made at the points of intersection of odd-numbered rows and cross marks and midway between cross marks in even-numbered rows.

Dowfume MC-2 was applied to the plots under sealed polyethylene covers from 1-pound cans fitted with adapters and plastic tubing. The plastic covers were left on the plots for 48 hours after application.

Dosages of fumigants were maximal and roughly proportional to the moisture equivalent rating of each soil type in order to assure effective control of plant parasitic nematodes. Moisture equivalent estimates are in Table 1 and dosages of fumigants used in the first 15 experiments are in Table 3.

Sampling Procedures.—Pint soil samples were taken from the plots with a sampling tube by removing a core of soil ¾ inch in diameter to a depth ranging from 6 to 8 inches. Crops in 4-row plots were sampled by removing soil at random from the root zones of plants in the 2 center rows. Crops of closely-spaced plants were sampled by removing soil at random from the plots, irrespective of row positions. The soil was collected in plastic bags which were then sealed and taken to the laboratory within 2 to 3 days and processed for extraction of nematodes by the

---

[3] D-D mixture is a 97 per cent mixture of 1,3-dichloropropene and 1,2-dichloropropane and 3 per cent lighter and heavier saturated and unsaturated hydrocarbons. It contains a minimum of 50 per cent by weight of the 1,3-dichloropropene fraction and weighs 10.00 pounds per gallon. Dowfume W-85 is a mixture of 83 per cent 1,2-dibromoethane and 17 per cent naphtha thinner and weighs 14.46 pounds per gallon. Nemagon is 97 per cent 1,2-diobromo-3-chloropropane and 3 per cent other halogenated C_3 compounds and weighs 17.30 pounds per gallon. Dowfume MC-2 is 98 per cent methyl bromide and 2 per cent chloropicrin dispensed in 1-pound cans. The D-D mixture and Nemagon were supplied by The Shell Chemical Corporation of New Orleans, La. The Dowfume W-85 and Dowfume MC-2 were made available by the Dow Chemical Company of Greenville, Miss.

Table 1.—Design, location and soil characteristics in soil fumigation experiments made in Louisiana in 1955 and 1956

Experiment[a]	Year	Location[b]	Crop	Description of Soil Type	M.E.[c]
1	1955	Homer	corn	Lakeland fine sand	6
2	"		oats		
3	"		"		
4	"		sorgo		
5	1956		"		
6	"		pine seedlings		9
7	1955	Curtis	corn	Yahola very fine sandy loam	16
8	1956		"		
9	1955		soybeans		
10	1956		"		
11	1955	Crowley	rice	Crowley silt loam	20
12	1956		"		
13	1956	Winnsboro	corn	Richland silt loam	22
14	"		cotton		
15	1955	St. Joseph	"	Commerce very fine sandy loam	15
16	1955	DeRidder	lespedeza	Bowie very fine sandy loam	8
17	"	Ragley	rice	Beauregard silt loam	12
18	1956	Magnolia	citrus	Sharkey clay	40
19	1955	Calhoun	peaches	Ruston fine sand	7
20	"	Robson	pecans	Miller silty clay loam	35
21	1956	Baton Rouge	sugar cane	Sharkey clay loam	35

[a] Experiments were in randomized blocks or Latin squares, usually with 16 plots, but ranging from 9 to 36. Good control of nematodes, based on results of "kill sampling" taken 2 weeks after fumigation, was achieved in experiments 1-15 but not in 16-17. Experiments 18-21 have been initiated but not concluded.

[b] Experiments were conducted in cooperation with Louisiana Agricultural Branch Experiment Stations located as indicated; except at Robson, on the U.S.D.A. Pecan Field Station, at Magnolia on the Magnolia plantation in cooperation with Mr. Ralph Lally and the Plaquemines Parish Experiment Station, and at Ragley in cooperation with Mr. W. H. Habetz.

[c] An approximate moisture equivalent (M.E.) was estimated for each soil type by Mr. S. A. Lytle and Dr. W. H. Patrick. Moisture equivalent is defined as per cent available moisture = (Field capacity — moisture at wilting point).

method of Christie and Perry (5). Sampling intervals during the crop season with annual crops varied from 4 to 6 weeks, following a determination of nematode numbers 2 weeks after fumigation as the first or "kill sampling." Perennial crops were sampled at intervals of 3 months following the initial "kill sampling."

Enumeration of Nematodes.—In the experiments conducted in 1955 approximately 10 ml. of suspension were drawn from each extraction funnel into a Syracuse watch glass marked near the center with a circle of area 1/7 that of the glass. The circle was divided into quadrants, each representing 1/28 of the glass area. Originally, the counts were equated to numbers per pint of soil by use of the factors 7 or 28. For statistical analysis all values were reconverted to 1/7 pint of soil basis and are so presented in the tables. In the 1956 experiments, a Syracuse watch glass, marked with cross rectangles, was used for counting the nematodes from individual extraction funnels. The rectangles comprised 1/7 of the total area of the watch glass, and only 2 passes across the watch glass were necessary for scanning the marked area under a dissecting microscope. These narrow rectangles permitted more accurate counting than the use of circles of equal area in the central part of the watch glass; in the rectangles, the radial variations in nematode distribution are included and averaged in each count. Counts were made with stereoscopic dissecting microscopes at magnifications of 13, 30 and 75 diameters.

The nematode counts in 1955 were confined to plant parasitic and suspected plant parasitic species.[4] In 1956, total nematodes were added to the counts. The frequent occurrence of other suspected plant parasitic nematodes such as species of *Neotylenchus* and *Boleodorus* in the samples was not recorded, thus enabling a simplification of identification and counting procedures.

Preliminary Evaluation of Sampling Methods.—The high numbers of nematodes extracted from soil by certain European investigators in contrast to the relatively low numbers obtained with the method of Christie and Perry, made necessary a critical examination of their method prior to general use. Overgaard Nielsen (24) obtained numbers of free-living nematodes per 1/7 pint of soil basis ranging from 666 to 27,175, with a mean of 10,154, from 13 sampling areas in a group of cultivated mineral soils in Denmark. It is rare when the standard Christie and Perry method or other modified Baermann methods will yield more than 2,000 nematodes per 1/7 pint of soil in Louisiana, regardless of soil type or crop. Its reproducibility was tested by analyzing a series of pint soil samples removed from a rice field transect at intervals of 10 feet. After processing, the following nematodes and nematode groups were counted in each sample: *Tylenchorhynchus martini* Fielding 1956 (the only parasitic species present), *Tylenchus* spp., *Psilenchus* spp. dorylaimoid groups and saprophytic groups. Variation in numbers of the three most abundant forms was consistent in 7 of the 9 samples, indicating proportional extraction and enumeration. Since the method is sufficiently sensitive to detect differences between replicate samples (experimental error), it was considered reliable for determining treatment differences.

---

[4] *Tylenchus* species, *Psilenchus* species and *Ditylenchus intermedius* (de Man 1880) Filipjev 1936 have not been implicated as parasites of higher plants. Since they possess the same morphological attributes as the plant parasitic species they are called suspected plant parasites.

Evaluation of Fumigants.—The economic comparison of soil fumigants is based commonly on a correlation of crop response with degree of nematode kill observed in initial samples. In this work, the principal objective was an evaluation of fumigant-nematode interactions. Therefore, population reduction in each experiment was based on the average of all samplings throughout the growing season. In addition to contributing fundamental information, this analysis has resulted in a more efficient utilization of data, much of which would have been discarded in initial sampling comparisons because of low nematode numbers.

EXPERIMENTAL RESULTS

The occurrence of plant parasitic nematodes in the experiments is detailed in Table 2. The most frequently occurring genera were *Pratylenchus, Trichodorus, Tylenchorhynchus, Xiphinema, Hoplolaimus* and *Helicotylenchus.* The species occurring most commonly in the experiments were an undescribed *Tylenchorhynchus* species, *Hoplolaimus coronatus* Cobb 1923 and *Xiphinema americanum* Cobb 1913. The suspected plant parasites *Tylenchus* species, *Psilenchus* species and *Ditylenchus intermedius* (de Man 1880) Filipjev 1936 were found in virtually all experiments. The distribution of all commonly occurring species was generally unrelated to soil type. This is demonstrated in the plant parasites by the

Table 2.—Occurrence of plant parasitic nematodes in 21 soil fumigation experiments made in Louisiana in 1955 and 1956

Nematodes[a]	Occurrence in experiments
Pratylenchus zeae Graham 1951	1, 7, 8, 13, 21
Pratylenchus spp.	2, 3, 4, 5, 9, 10, 13, 14, 15, 16, 18, 21
Trichodorus spp.	1, 2, 3, 4, 5, 7, 8, 9, 10, 15, 16, 20, 21
Tylenchorhynchus acutus Allen 1955	1, 2, 4, 5, 7, 8
Tylenchorhynchus species	2, 6, 7, 8, 9, 10, 13, 14, 15, 16, 19, 21
Tylenchorhynchus martini Fielding 1956	11, 12, 21
Xiphinema americanum Cobb 1913	1, 2, 4, 5, 6, 15, 16, 18, 19, 21
Helicotylenchus spp.	1, 2, 6, 7, 9, 10, 14, 15, 16, 18, 19, 21
Hoplolaimus coronatus Cobb 1923	1, 6, 9, 10, 15, 16, 19
Criconemoides spp.	4, 5, 6, 18, 19, 21
Paratylenchus spp.	16, 19, 20
Meloidogyne spp.	15, 19
Radopholus oryzae (v. Breda de Haan 1902) Thorne 1949	12, 17
Rotylenchulus sp.	16,18
Rotylenchus sp.	1
Tylenchulus semi-penetrans Cobb 1913	18
Criconema sp.	6

[a] Suspected plant parasitic nematodes *Tylenchus* spp., *Psilenchus* spp. and *Ditylenchus intermedius* (deMan 1880) Filipjev 1936 occurred in virtually all experiments.

occurrence of mixed populations of the same *Tylenchorhynchus* species at Homer, Curtis and DeRidder.

Effectiveness of Fumigation.—Fumigation treatment was generally effective in reducing nematode populations in the "kill samples" in all experiments, except numbers 16 and 17. Comparisons of fumigants based on combined samplings for nematodes throughout the growing season will be presented in another section.

Statistical Evaluation of Data.—Tabulation of the data in terms of samplings and treatments was made for the first 15 experiments. Species of three genera were selected for detailed analyses. These were *Pratylenchus zeae, Pratylenchus* species, *Trichodorus* species and *Tylenchorhynchus* species comprising pure and mixed populations, as indicated. Two objectives were pursued in the analysis of individual experiments: (1) to determine the proportion of significant differences between samplings within individual treatments and (2) to determine the

Table 3.—Fumigants, their dosages and effects in reducing populations of *Pratylenchus* (P), *Trichodorus* (T) and *Tylenchorhynchus* (TYR) in soil fumigation experiments made in Louisiana in 1955 and 1956

	Fumigant and dosage				Genera of plant parasites	
	Gal./A.			Lbs./100 sq. ft.		Populations[a] reduced significantly throughout growing season
Experiment	D-D Mixture	Dowfume W-85	Nemagon	Dowfume MC-2	Occurrence	
1	25	7	3.5		P,T,TYR	P
2	25	7.5	3		P,T,TYR	P
3	25		1	2	P,T	
4	25			2	P,T,TYR	P,T
5	25	5	1		P,T,TYR	P
6	25	7.5	7.5	2	TYR	
7	25	7		2	P,T,TYR	P,TYR, TOTAL
8	25		2	2	P,T,TYR	
9	25	7		2	P,T,TYR	TYR, TOTAL
10		6	2	2	P,T,TYR	
11	40	7		3	TYR	TYR
12	42			3	TYR	
13	25				P,TYR	
14		5			P,TYR	
15	30	10	4		P,T,TYR	

[a] Populations reduced significantly by one or more fumigants, as determined by statistical analysis of combined data from all samplings. Analyses of population reductions in total nematodes (TOTAL) were confined to experiments 5, 7, 9, 11, 14. Fumigation was considered effective in all 15 experiments because of the absence of plant parasitic nematodes in "kill samples" taken 2 weeks after fumigation.

proportion of significant reductions in populations below the controls by individual fumigants across samplings.

For purposes of this work, a population of nematodes must be defined as an individual species or as a mixture of known or unknown species belonging to a single genus. Designations such as *T. martini, Psilenchus* species and *Tylenchorhynchus* species indicate the character of populations in individual experiments. Where similar populations occurred in several experiments discussed jointly, they have been referred to in a plural sense, as in the above sentence.

Numbers of nematodes in the pure and mixed populations varied widely between experiments and in the different samplings and treatments of individual experiments. Ranges and means in the distribution of numbers, however, were generally related for numbers of *Pratylenchus, Trichodorus* and *Tylenchorhynchus* species from nonfumigated control plots. The nature of the data indicated that the lower numbers of these and other genera encountered in treated plots would probably approximate a Poisson distribution, if sufficient replications could be secured for conformance tests.

In order to evaluate the methods of enumeration of nematodes and to study the characteristics of nematode data from the statistical standpoint, 120 different pint soil samples were secured from a 20 x 20 feet square of Coastal Bermuda grass sod at Homer, La. *Xiphinema americannum* occurred in extremely small numbers, following among 1/7 pint aliquots, an ideal Poisson distribution. By restricting the counting field and determining *Trichodorus* spp. in 1/28 pint aliquots, it was possible here also to achieve close conformance with a Poisson distribution. *Tylenchorhynchus acutus* Allen 1955, however, in 1/28 pint aliquots, yielded a mean number of 23 with a variance of 58, and the distribution of its numbers approximated the characteristics of a normal distribution. With increase in numbers over 20 per 1/28 of the watch glass area, the enumeration system became progressively less definitive; for example, with a mean of 60 the variance was 472, indicating difficulties in both counting and maintaining uniform distribution of nematodes over the watch glass surface.

Most of these difficulties have been avoided in the fumigation plot work by the counting of individual genera and species, which almost always occurred in smaller numbers than 20 per 1/7 of the field. The counting of small numbers of a particular form, which must be searched out, is more accurate than the counting of large numbers because the viewer is, in effect, counting a number of fields. Under the medium power magnification of the microscope used in the work, 1/7 of the watch glass area is approximately 16 times the field diameter. In order to scan this area the viewer must count at least 16 fields.

Analysis of Data on Pure and Mixed Populations of Pratylenchus, Trichodorus and Tylenchorhynchus Species.—The sets of data analyzed for sampling and treatment differences totaled 145. Duplicate analyses were made with the transformations $\sqrt{X + .5}$ and log (X + 1), where nematode numbers were low and included zero; and with $\sqrt{X}$ and log X where numbers were high. A total of 290 separate analyses of variance were conducted with the help of I.B.M. facilities at Louisiana State Uni-

Table 4.—Proportions of statistically significant sampling and treatment comparisons[a] in 290 analyses of the population behavior of *Pratylenchus, Trichodorus* and *Tylenchorhynchus* species in soil fumigation experiments made in Louisiana in 1955 and 1956

Statistical Transformation[b]	Sampling comparisons Total	Sampling comparisons Significant 5%	Sampling comparisons Significant 1%	Treatment comparisons Total	Treatment comparisons Significant 5%	Treatment comparisons Significant 1%
$\sqrt{X + .5}$	97	11	25	21	2	9
log (X + 1)	97	10	26	21	5	8
$\sqrt{X}$	20	5	7	7	0	4
log X	20	4	9	7	0	4
Total	234	30	67	56	7	25

[a] Significant differences between; (1) samplings indicated intraseasonal fluctuations in nematode populations caused by unknown factors, and (2) treatments indicated reductions in nematode populations by one or more fumigants.

[b] Duplicate analyses were conducted on each set of data comparing $\sqrt{X + .5}$ with log (X + 1), when numbers were low and included zero and $\sqrt{X}$ with log X, when numbers were high.

Table 5.—Numbers of *Pratylenchus* species by sampling in control plots of fumigation experiments made in Louisiana in 1955 and 1956

Experiment[a]	Plots per sampling	Average numbers per 1/7 pint soil by sampling[b] 1	2	3	4
1	3	4.7	17.4	5.6	9.0
4**	4	2.3	2.0	15.3	45.3
5**	4	3.8	1.0	4.0	64.5
7	4	6.6	17.1	8.0	20.5
8	4	7.3	1.0	12.3	
9	4	0.4	0.0	3.1	3.0
10	4	1.0	10.3	3.7	6.5
15	4	0.3	2.0	4.0	1.4

[a] Asterisks indicate statistically significant intraseasonal fluctuations in populations; (*) indicates 5% and (**) 1% levels of significance.

[b] Sampling intervals ranged from 4 to 6 weeks in all experiments following the initial "kill sampling" 2 weeks after fumigation.

versity. Two hundred and thirty-four of these were sampling comparisons and 56 were comparisons of fumigant effects.

A summary of the results of the statistical analyses is in Table 4. Significant intraseasonal (short cycle) fluctuations occurred in 97/234 analyses (41.5 per cent) and significant reductions in nematode populations in 31/65 analyses (55.4 per cent). The square root and log transformations were generally equivalent in terms of the per cent of experiments yielding significant intraseasonal fluctuations in populations of the different genera and in the reductions of their populations by fumigants. The number of analyses yielding significance at the 1 per cent level was more than double that at the 5 per cent level. There was no relation between F value and the average sample or sample of the highest number of nematodes.

Population Trends of Species of Pratylenchus, Trichodorus and Tylenchorhynchus.—*Pratylenchus* species, including *P. zeae,* occurred in 12 of the 15 experiments studied intensively. Those listed in Table 5 yielded relatively high populations of *Pratylenchus* species. Populations increased generally throughout the growing season in all 8 experiments and fluctuated significantly between samplings in experiments 4 and 5.

Species of *Trichodorus* occurred abundantly in control plots of 7 of the 15 experiments (Table 6). There was a net rise in populations, following each initial sampling, in these 7 experiments. Statistical significance of sampling differences was confined to experiments 4 and 5, as with species of *Pratylenchus.* In 4 of the 7 experiments, there was a delayed build-up of *Trichodorus* species during the crop season. One peculiarity was the frequency of occurrence of zero numbers in certain samplings, although the nematodes were quite abundant at other periods.

Table 6.—Number of *Trichodorus* species by sampling in control plots of fumigation experiments made in Louisiana in 1955 and 1956

Experiment[a]	Plots per sampling	Average numbers per 1/7 pint soil by sampling[b]				
		1	2	3	4	5
1	3	0.0	0.0	0.0	0.0	1.3
4**	4	0.0	8.0	22.5	39.0	
5**	4	17.0	0.0	0.0	51.3	
7	4	2.0	0.0	8.2		
8	4	3.3	8.0	8.5		
10	4	13.0	13.5	0.0	0.3	
15	4	0.0	0.0	0.0	10.0	

[a] Asterisks indicate statistically significant intraseasonal fluctuations in populations; (*) indicates 5% and (**) 1% levels of significance.

[b] Sampling intervals ranged from 4 to 6 weeks in all experiments following the initial "kill sampling" 2 weeks after fumigation.

Table 7.—Numbers of *Tylenchorhynchus* species by sampling in control plots of fumigation experiments made in Louisiana in 1955 and 1956

Experiment[a]	Plots per sampling	Average numbers per 1/7 pint soil by sampling[b]				
		1	2	3	4	5
1	4	0.0	0.0	3.0	0.0	
4	3	2.0	0.0	0.0	0.0	
5	4	5.3	1.3	0.3	48.0	
7*	4	85.7	14.8	43.4		
8**	4	16.5	14.0	69.3		
9**	4	10.1	3.5	12.2	0.3	44.6
10*	4	14.5	7.0	17.8	109.0	
11**	4	16.1	47.4	1.6	31.0	
12	3	4.8	2.5	0.5	1.5	0.3
15	4	1.3	0.0	0.0	0.0	

[a] Asterisks indicate statistically significant intraseasonal fluctuations in populations; (*) indicates 5% and (**) 1% levels of significance.

[b] Sampling intervals ranged from 4 to 6 weeks in all experiments following the initial "kill sampling" 2 weeks after fumigation.

There was a general tendency also for the different populations to rise to abnormal levels in fumigated plots, in agreement with the observations of Perry (25, 26) on the stubby root nematode (*Trichodorus* sp.) in Florida.

Species of *Tylenchorhynchus* occurred abundantly in 10 of the 15 experiments analyzed intensively. Five of these exhibited significant intraseasonal fluctuations in populations (Table 7). It is interesting to note that 4 of the 10 experiments show sustained decreases in populations following the initial sampling.

Population Trends of Species of Tylenchus and Psilenchus.—The data in Table 8 reveal similar population trends for both genera of suspected plant parasites. In 11 of the 13 experiments, the populations of *Tylenchus* species in the first two samplings were greater than or equal to those in the last two. In *Psilenchus* species, 8 of the 12 experiments showed this population trend. In spite of the general decline in populations of both genera during the growing season, there was a distinct tendency for a population rise between first and second samplings, particularly in *Tylenchus* species. There was a tendency also for a population decline between first and second samplings in species of both genera, particularly with *Psilenchus* species. A population rise between the first and second sampling was almost invariably connected with a sharp drop between the second and third sampling. There were only two instances of population increase in *Tylenchus* species and four in *Psilenchus* species between second and third samplings. In general, these data demonstrate a population decline in species of *Tylenchus* and *Psilenchus,* which stands

Table 8.—Numbers of *Tylenchus* and *Psilenchus* species by sampling in control plots of fumigation experiments made in Louisiana in 1955 and 1956

Experiment	Plots per sampling	Average numbers per 1/7 pint soil by sampling[a]			
		1	2	3	4
		Tylenchus species			
1	3	1.3	0.7	0.0	0.0
4	4	2.0	0.0	0.0	0.0
5	4	3.8	0.0	0.0	0.0
6	5	1.0	12.8	1.8	3.0
7	4	0.0	3.0	0.0	0.0
8	4	0.5	3.0	3.0	
9	4	1.0	0.0	1.7	0.0
10	4	0.0	12.0	0.0	0.3
11	4	1.0	0.0	0.0	1.0
12	3	0.0	10.0	4.3	2.3
13	4	0.0	11.3	13.5	0.0
14	4	0.8	22.0	6.8	1.5
15	4	9.1	33.0	0.0	0.0
		Psilenchus species			
4	4	0.0	0.0	0.3	0.0
5	4	0.5	0.3	0.8	0.3
6	5	0.5	0.0	0.0	0.0
7	4	3.3	9.0	0.0	0.0
8	4	1.0	0.3	0.0	
9	4	0.3	0.0	2.4	0.0
10	4	0.0	14.8	0.3	0.0
11	4	7.7	14.0	0.3	0.7
12	3	34.0	1.0	0.0	0.7
13	4	17.5	9.5	0.3	0.0
14	4	1.0	5.5	1.0	0.0
15	4	1.3	0.0	23.4	0.0

[a] Sampling intervals ranged from 4 to 6 weeks in all experiments following the initial "kill sampling" 2 weeks after fumigation. Statistical analyses were not made on populations of these genera.

in contrast to the population trends of the plant parasitic nematodes. Numbers of *Ditylenchus intermedius* in the experiments were too low to indicate a characteristic population trend, and were not included with the data in Table 8.

Correlation of Intraseasonal Fluctuations in Populations of Tylenchorhynchus Species with Rainfall and Flood Periods.—Populations of *Tylenchorhynchus* species in soybeans and *T. martini* in rice manifested significant intraseasonal fluctuations. In soybeans, these fluctuations were perfectly correlated with rainfall at Curtis in 1955 for each 2-week period prior to sampling (Figure 1). High rainfall was correlated with low num-

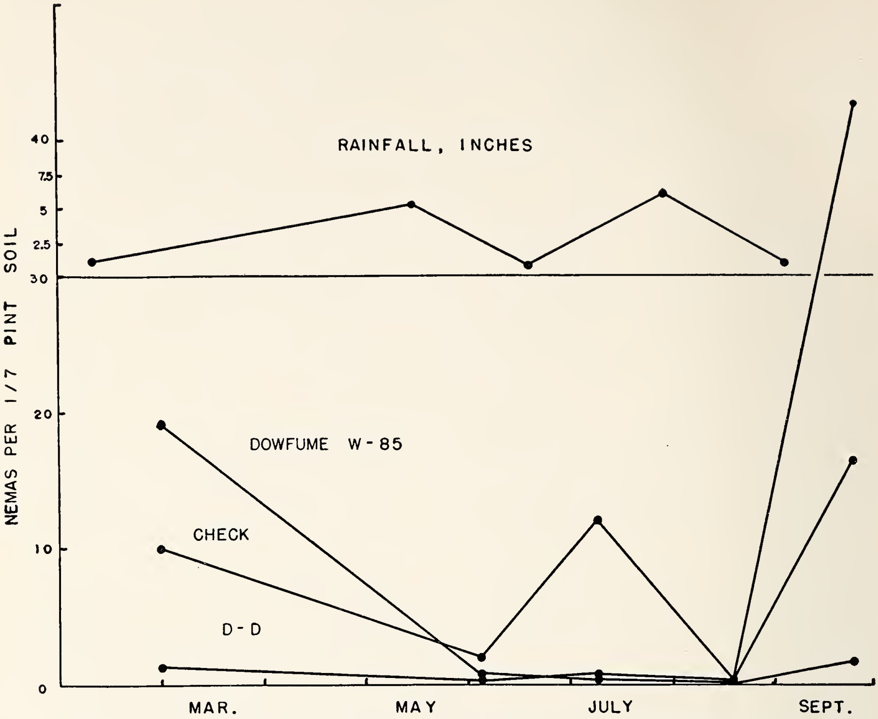


Figure 1.—Correlation of rainfall with intraseasonal fluctuations in mixed populations of *Tylenchorhynchus* species in soybeans at Curtis, La., in 1955.

bers and low rainfall with high numbers of nematodes. Similar correlations occurred between populations of *T. martini* and water applications to rice for flooding at Crowley in 1955 (Figure 2). High numbers occurred in samplings 1, 2 and 5, following periods when the plots had not been flooded with water. The occurrence of low rainfall throughout Louisiana in 1956 probably prevented the reoccurrence of these results. However, Figure 3 exhibits the fluctuations obtained in populations of total nematodes, *T. martini* and *Radopholus oryzae* (V. Breda de Haan, 1902) Thorne 1949 in the 1956 rice experiment at Crowley. Water was removed from this experimental plot during one 14-day period of the growing season, but rainfall in this interval prevented the soil moisture from falling below the saturation level. The curves in Figure 3 indicate extremely low numbers of plant parasitic nematodes throughout the experimental period. Adjacent nonflooded areas of white Dutch clover, infested with *T. martini,* commonly yielded 10 times as many specimens per 1/7 pint of soil. Fluctuations in populations were statistically significant only for *R. oryzae.*

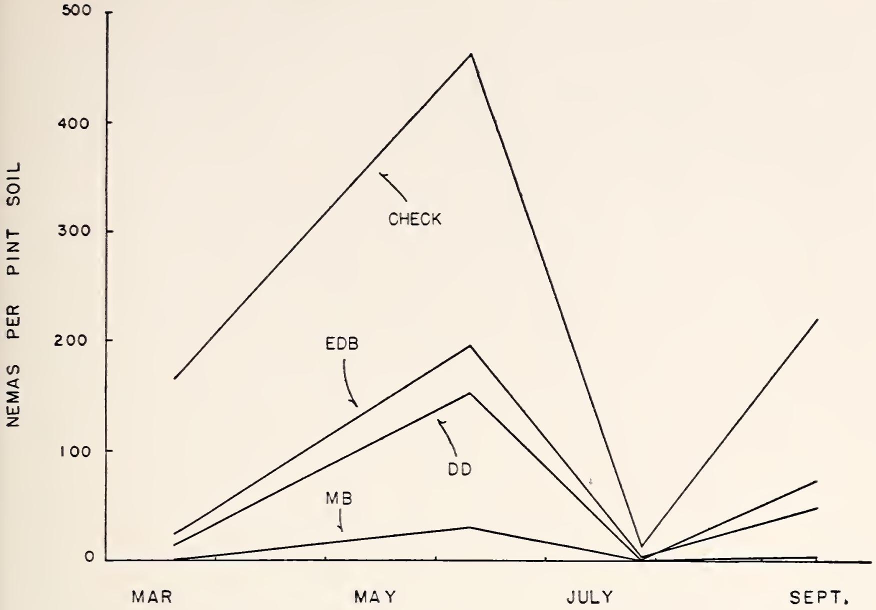


Figure 2.—Occurrence of intraseasonal fluctuations in populations of *Tylenchorhynchus martini* Fielding 1956 in rice at Crowley, La., in 1955.

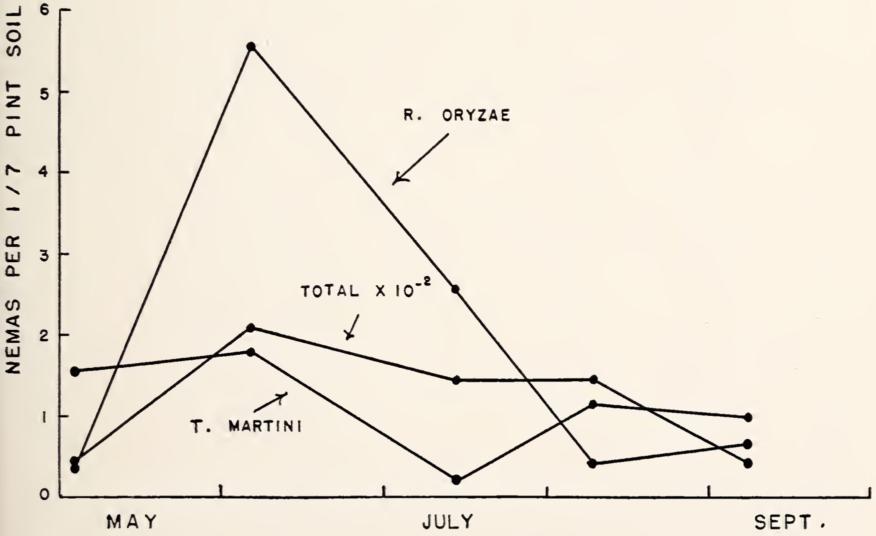


Figure 3.—Parallel fluctuations in populations of *Tylenchorhynchus martini* Fielding 1956, *Radopholus oryzae* (v. Breda de Haan 1902) Thorne 1949 and total nematodes in rice at Crowley, La., in 1956. (Numbers of total nematodes are divided by 100.)

Generic Differences in the Population Recovery of Nematodes Following Fumigation.—Interactions between the various fumigants and populations of plant parasitic and suspected plant parasitic nematodes were analyzed by a unique method of combining data from 15 experiments. A sample of the data converted to percentage reduction in populations of five genera throughout the growing season by D-D mixture is in Table 9. The genera are ranked in Table 10 according to their relative reactions to D-D mixture in each experiment. A high rating indicates effective suppression by the fumigant or a relatively weak recovery by the population. A low value indicates a relatively strong recovery by a population after fumigation. The ratings are summed and each sum divided by the number of comparisons for the genus. A highest possible mean (HPM) is similarly calculated and a final percentage for each genus is based on this, as shown at the bottom of the table. Interactions with each fumigant were treated in the same manner.

The data are summarized in Table 11. *Tylenchorhynchus* species (TYR), comprised principally of *T. acutus,* an undescribed species of *Tylenchorhynchus* and to a less extent by populations of *T. martini,* exhibited, in aggregate, the weakest population recovery to all fumigants. The behavior of *Pratylenchus* species (P), comprised of *P. zeae* and several undetermined species, was erratic, owing to the differential effects

Table 9.—Sample of data showing reactions of 5 genera[a] of plant parasitic nematodes to D-D mixture in fumigation experiments made in Louisiana in 1955 and 1956

		Per cent reduction[b] in populations (all samplings)				
Exp.	Samples	TYR	P	T	PS	TY
1	12	100	99	-650	..	88
2	16	100	-100	35	43	36
3	18	...	77	77	52	58
4	16	100	95	- 59	..	..
5	16	78	82	52	..	60
6	10	- 82	...	...	..	28
7	16	79	33	- 81	84	42
8	12	- 18	42	37	20	73
9	20	72	49	...	..	100
10	16	...	...	...	..	..
11	20	75	...	...	76	..
12	15	55	...	...	-17	-62
13	16	...	...	...	52	55
14	16	...	...	...	..	..
15	16	...	46	90	9	- 2

[a] The generic names are abbreviated as follows: *Tylenchorhynchus* (TYR), *Pratylenchus* (P), *Trichodorus* (T), *Psilenchus* (PS) and *Tylenchus* (TY).

[b] A negative (—) per cent reduction indicates a per cent increase in the population.

Table 10.—Method of evaluating data on the relative reaction of plant parasitic nematodes[a] to D-D mixture in fumigation experiments made in Louisiana in 1955 and 1956

	Relative reaction				
Exp.	TYR	P	T	PS	TY
1	4	3	1		2
2	5	1	2	4	3
3		4	3	1	2
4	3	2	1		
5	3	4	1		2
6	1				2
7	4	2	1	5	3
8	1	4	3	2	5
9	2	1			3
10					
11	1			2	
12	3			2	1
13				1	2
14					
15		3	4	2	1
Totals	27	24	16	19	26
Comparisons	10	9	8	8	11
Mean	2.70	2.67	2.00	2.38	2.36
Highest possible mean (HPM)	3.60	4.11	4.25	3.75	3.64
M/HPM in per cent	75.00	64.96	47.06	63.47	63.27

[a] The generic names are abbreviated as follows: *Tylenchorhynchus* (TYR), *Pratylenchus* (P), *Trichodorus* (T), *Psilenchus* (PS) and *Tylenchus* (TY).

Table 11.—Relative population recovery of five genera of plant parasitic nematodes following fumigation in relation to different soil fumigants in experiments made in Louisiana in 1955 and 1956. (Complete relative recovery = 100 per cent)

Nematode[a]	Dowfume MC-2	D-D mixture	Dowfume W-85	Nemagon	Mean	Reaction
TYR	40.00	25.00	9.87	5.66	20.13	Weak
P	43.75	35.04	46.62	13.05	34.62	Moderately weak
T	53.81	52.94	51.88	54.25	53.22	Strong
PS	46.50	36.53	47.88	52.94	45.96	Strong
TY	57.14	36.73	44.18	57.14	48.80	Strong

[a] Nematode populations were: TYR—*Tylenchorhynchus acutus* + *Tylenchorhynchus* species; P—*Pratylenchus zeae* and *P.* spp.; T, PS and TY—*Trichodorus, Psilenchus and Tylenchus* species, respectively.

of Dowfume W-85, but in reaction to three of the four fumigants, manifested a moderately weak population recovery. *Trichodorus* species (T) made the strongest recovery to fumigation, followed closely by species of *Tylenchus* (TY) and *Psilenchus* (PS). In general, the data separated the genera into two groups, weak and strong, in their population recovery following fumigation. *Pratylenchus* species, however, occupy an intermediate position and must be classed as moderately weak in reaction.

The statistical conclusions listed in Table 3 are in essential agreement with this analysis. In 3 of 13 experiments, populations of *Tylenchorhynchus* species were significantly reduced during the entire growing season by one or more soil fumigants. Significant reductions of *Pratylenchus* species occurred in 5 of 12 experiments. Populations of *Trichodorus* species were reduced significantly in only 1 of 10 experiments.

Relation of Fumigant Vapor Pressure to the Recovery of Nematode Populations.—Figure 4 illustrates the relation between the fumigants arranged in order of decreasing vapor pressure and a progressive increase in their tendency to differentiate between weak and strong groups of nematodes. It is evident that relative recovery of the strong genera was

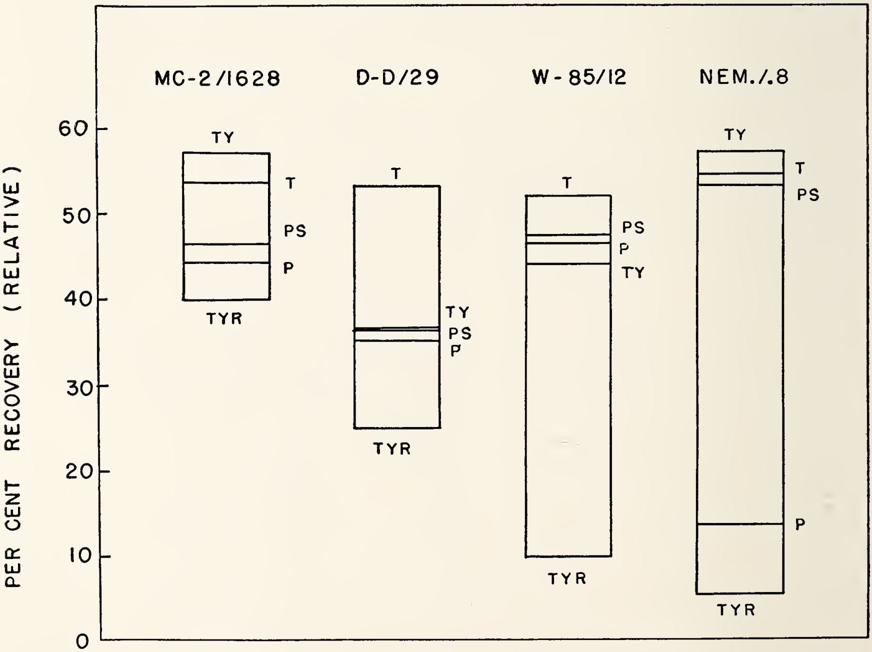


Figure 4.—Relation of fumigant vapor pressure to the population recovery of different genera of plant parasitic nematodes following fumigation in experiments made in Louisiana in 1955 and 1956. Generic designations are *Tylenchorhynchus* (TYR), *Pratylenchus* (P), *Psilenchus* (PS), *Tylenchus* (TY) and *Trichodorus* (T).

influenced very little by differences in fumigants under the conditions of these experiments. However, the progressive decrease in per cent relative recovery of populations of *Tylenchorhynchus* species and *Pratylenchus* species indicates a definite inverse relation between the vapor pressure of a fumigant and its suppressive effect against weak and moderately weak nematodes.

Comparative Efficiency of Fumigants.—The general effects of fumigants on six common genera of plant parasitic nematodes are compared in Table 12. Comparisons could be made, either in terms of populations or constancy percentages, since both are aspects of nematode occurrence. Constancy percentage is the percentage of samples containing a given nematode. It was introduced into nematode sampling studies by Overgaard Nielsen (24) and is particularly useful for comparing nematode populations of low numbers and sporadic occurrence in diverse habitats. Its use here enables the inclusion of data on *Ditylenchus intermedius*.

The most effective reduction of constancy percentages was by Dowfume MC-2, followed in order of decreasing effectiveness by Nemagon, Dowfume W-85 and D-D mixture. The last three fumigants fall in the order of an increasing vapor pressure series. Within broad limits, the reductions in constancy percentages by the fumigants are proportional and independent of nematode genus. The one exception is Nemagon. This fumigant showed very little effect against the suspected plant parasitic nematodes, as reflected in the constancy percentages of occurrence of species of *Tylenchus, Psilenchus* and *Ditylenchus*.

There were two additional differential interactions of fumigants with nematodes and soil types. A clearcut difference in fumigant action was noted with D-D mixture and Dowfume W-85 against populations of *T. acutus* and an undescribed species of *Tylenchorhynchus* in corn and soybeans at Curtis. A breakdown of the combined numbers of these nema-

Table 12.—Constancy percentage[a] of common nematode genera[b] by treatment in combined samplings of fumigation experiments made in Louisiana in 1955 and 1956

Treatment	P	T	TYR	TY	PS	DY	Mean
Check	54.1	33.7	55.2	21.4	22.6	6.5	32.3
Dowfume MC-2	18.3	12.5	28.3	5.0	5.2	5.7	12.5
D-D mixture	33.1	22.4	40.1	19.0	12.4	7.8	22.5
Dowfume W-85	26.7	18.3	36.3	14.0	10.1	3.7	18.2
Nemagon	21.8	12.8	24.6	25.0	13.4	8.3	17.7

[a] Constancy percentage is the percentage of occurrence in the samples from the different treatments.

[b] The generic names are abbreviated as follows: *Pratylenchus* (P), *Trichodorus* (T), *Tylenchorhynchus* (TYR), *Tylenchus* (TY), *Psilenchus* (PS) and *Ditylenchus* (DY).

Table 13.—Differential effect of fumigants on populations of *Tylenchorhynchus acutus* and *Tylenchorhynchus* species in corn and soybean fumigation experiments at Curtis, Louisiana in 1955

		Average numbers per 1/7 pint soil[a]		
Crop	Sampling	Check	D-D mixture	Dowfume W-85
Corn	1	82	4	73
	2	15	2	2
	3	44	25	4
Total		141	31	79
Soybeans	1	10	2	19
	2	4	0	1
	3	12	0	0
	4	1	0	0
	5	45	9	2
Total		72	11	22

[a] Sampling and treatment differences were highly significant at $P = 0.01$ in both experiments.

todes by sampling period, in both experiments, (Table 13) reveals that D-D mixture reduced numbers early whereas Dowfume W-85 caused a reduction in numbers primarily near the end of the crop season. These results can be explained by the differences in vapor pressure of the fumigants. Soil types at two locations exerted differential effects on fumigant effectiveness against *Pratylenchus* species. D-D mixture was more effective than Dowfume W-85 in reducing numbers of *Pratylenchus* species in both corn and soybeans at Curtis; however, Dowfume W-85 was more effective against these same nematodes in corn and oats at Homer (data not shown). The soil at Curtis is much heavier in texture than at Homer and again the results are explicable in terms of fumigant vapor pressure.

DISCUSSION

In mathematics, provable hypotheses are deduced from unprovable fundamental assumptions. The theoretical justification for the arrangement of these data along generic lines rests on the same foundation. The results derived experimentally in this work support the fundamental assumption that nematodes possess sufficient complexity of structure and organization that certain facets of their population behavior should be predeterminable at the generic level. In particular, the existence of differences at the generic level should derive from the basic cause and effect relation between structure and function, verified whenever the elements are analyzed. It is known that structure determines function at higher taxonomic levels. The feeding habits and disease-producing ability of nematodes associated with higher plants are correlated with structural attributes such as the presence of (1) a spear or stylet, (2) basal spear or stylet knobs and (3) large esophageal glands. The grouping of species of plant parasitic nematodes into individual genera and the analysis of their numbers in the samples from the field plots have revealed characteristic population trends and reactions to halogenated hydrocarbons. Generic distinctions of this kind are common in all large groups of organisms, but they attract no attention because interest is focused on more definitive species and race differences.

Population distinctions among plant parasitic nematodes in soils may be based on (1) occurrence and distribution, (2) population trends including fluctuations in numbers and (3) reactions to chemicals. The relating of these characteristics to internal factors such as nematode morphology and specific ecologic factors has been dependent on the development of nematode taxonomy. Progress has been slow because nematode taxonomists have generally shunned the field of experimental ecology. Overgaard Nielsen (24) combined taxonomic and experimental methods in an exceptional study of the occurrence and distribution of free-living nematodes in Danish soils. He was able to separate the nematode species observed into three ecologic groups: (1) those widely distributed in all soil types (eurytopic species), (2) those confined to permanently moist locations, irrespective of the soil type (freshwater species) and (3) species of narrow distribution (stenotopic groups) confined to sand and raw humus.

The five known species included in this investigation which occurred commonly were distributed independently of soil type. These were *Tylenchorhynchus acutus, Tylenchorhynchus* species, *Xiphinema americanum, Hoplolaimus coronatus* and *Ditylenchus intermedius.* Distribution of the last named was independent of host plant and the other species exhibited wide host ranges, confirming and extending the results of nematode surveys in Louisiana (7, 17). The genera *Pratylenchus* and *Trichodorus,* each comprising several species, were widely but not universally distributed.

Tylenchorhynchus martini is known to parasitize several species of plants (4) and is confined primarily to southern Louisiana. This is the most common parasitic species in Louisiana rice fields (3) but Johnston (15) has shown the optimum soil moisture level for survival lies in the range of 40-60 per cent of the moisture-holding capacity. Since it reproduces most rapidly in the greenhouse at high temperatures, this factor may limit its northern distribution.

Certain distinctions were evident in the population trends of nematodes in the field plots. Populations of species of *Pratylenchus* and *Tricho-*

dorus increased during the crop season, providing circumstantial evidence of parasitic capabilities. Species of *Tylenchorhynchus* increased in numbers during the crop season, but there was a distinct tendency in the 1955 experiments for populations to fluctuate with rainfall and flooding practices, when these factors caused saturation of the soil for periods of several days. In general, the most violent intraseasonal fluctuations occurred in the ectoparasitic nematodes, their numbers frequently falling to zero or near zero in a sampling, then rising again at a later sampling. Although there were similar fluctuations in *Pratylenchus* species, the numbers rarely fell to extremely low levels. This probably reflects the protective influence of plant roots as a reservoir of reserve population. Here, as in the ectoparasitic forms, the fluctuations are discontinuous. Observations suggest that population changes in *Pratylenchus* species (20) and *Meloidogyne* species reflect an alternation of endoparasitic and ectoparasitic modes of existence.

Populations of the suspected plant parasitic nematodes generally decreased during the growing season, although there was a tendency for a rise between the first and second samplings. In the absence of pathological responses, this population decline constitutes circumstantial evidence of non-parasitic tendencies toward higher plants.

The occurrence of statistically-significant intraseasonal fluctuations in 41.5 per cent of the experiments analyzed indicates this is a common phenomenon. Their cause and significance are unknown but they must reflect the total incidence of several microbiological and edaphic factors. Their relation to rainfall and soil moisture stimulated laboratory work to determine if microbiological factors were involved in the periodic reduction of populations. Populations of *Tylenchorhynchus martini,* mixed with larger numbers of free-living nematodes, were partially disinfested of microorganisms by chemical treatments (13) and incubated for 10-day periods in saturated and moist soil further divided into sterile and nonsterile treatments. Consistently greater reductions in populations occurred in nonsterile saturated than in nonsterile moist soil, confirming field results and indicating further the effects of microbiological factors.

It is ironic that the type of fluctuations encountered in nematode populations, whether seasonal or intraseasonal, can be related to the frequency of sampling. This is the first report known to the authors of the occurrence of fluctuations on the basis of a 4-6 week cycle. The disagreement between results of European and American workers on the occurrence of fluctuations is puzzling, but it may result from differences in (1) sampling methods, (2) stability of biotic communities (native vs.

cultivated fields) or (3) purity of populations observed (one or many species).

In all of the field plot fumigation work in Louisiana the numbers of nematodes in the different groups observed in "kill samples" enable a rating of relative population recovery in descending order as follows: saprophytes = suspected tylenchoid plant parasites > tylenchoid plant parasites > free-living dorylaimoid forms. Population recovery ratings of the parasitic and suspected plant parasitic genera counted in soil samples were: *Trichodorus* = *Tylenchus* = *Psilenchus* > *Pratylenchus* > *Tylenchorhynchus*. Perry (25, 26) found that *Trichodorus* species was much stronger in population recovery following fumigation than *Belonolaimus gracilis* and *Dolichodorus heterocephalus*. Meadow and root knot nematodes appeared intermediate in strength of population recovery. Differential interactions between nematodes and fumigants observed by other workers furnish additional information on the relative population recovery of different genera and species following fumigation.

Differences in nematode reaction to soil fumigants in field plots cannot be interpreted at present in terms of resistance and susceptibility. Factors of resistance may reside in the presence of a resistant egg stage in fumigated soil. Generic and specific differences in the recovery of nematode populations in fumigated soil may also be related to (1) occurrence of natural enemies, (2) food supply, (3) differences in reproductive rates and (4) different population trends. The principal environmental factors known to promote the expression of differences in reaction to fumigants include: (1) specific fumigant, (2) soil type, (3) soil moisture level and (4) soil temperature.

The results of this investigation point out certain generic distinctions among nematodes in terms of their population trends and their reactions to fumigants. Their recognition is simplified by a systematic treatment of the effects of fumigants on nematodes as a function of their relative vapor pressures. In the range of 20-25° C., the vapor pressures in mm./Hg. are: Dowfume MC-2, 1628; D-D mixture, 29; Dowfume W-85, 12; and Nemagon, 0.8. Theoretically, their diffusion rate in soil is a function of vapor pressure and their degree of persistence in soils should increase down the scale of diminishing vapor pressures.

Dowfume MC-2 was the most efficient fumigant used in the experiments. Its killing action against all organisms in the soil was so complete in 48 hours that its lack of persistence was unimportant. It was followed in descending order of effectiveness, by Nemagon, Dowfume W-85 and D-D mixture. Their efficiency as nematocides, throughout the crop season, was related inversely to their vapor pressures. This suggests that their relative efficiency in soils resides in their degree of persistence or the spreading of their effects in time. The soil types utilized in the work ranged from extremely light to extremely heavy in physical character. In general the results represented an "average soil." Differential effects due to vapor pressure—soil texture interactions in individual tests were of rare occurrence and have been noted.

The relation between vapor pressure and persistence and the propensity of a fumigant to differentiate weak and strong nematodes was suggested by the graded reaction of *Tylenchorhynchus* species to the various fumigants arranged in order of decreasing vapor pressures. All data on the interactions of nematodes with fumigants have been found perfectly consistent with a vapor pressure or persistence theory of effectiveness, primarily against weak nematodes. In some instances the modifying influence of soil texture must be considered, as in the experience with Nemagon against *Trichodorus* species in Florida (18). Nemagon was the most effective fumigant in this case because its persistence was at a premium in light sandy soil. Results in the "average" Louisiana soil indicated there was no relation between fumigants in terms of their vapor pressures and the population recovery of *Trichodorus* species. Under these conditions, the superior killing action of a high vapor pressure fumigant such as D-D mixture apparently counterbalanced the superior persistence of the low vapor pressure fumigants such as Dowfume W-85 and Nemagon. Dowfume W-40 (low V.P.) was more effective against *Belonolaimus gracilis* (weak nematode) than *Pratylenchus* species (moderately weak nematodes) (10). Dowfume W-85 and Nemagon (low V.P.) were more effective against *Belonolaimus gracilis* (weak nematode) than D-D mixture (high V.P.) (12). Dowfume W-85 (low V.P.) was more effective against *Tylenchorhynchus claytoni* (weak nematode) than D-D mixture (high V.P.) but was less effective than the latter against meadow nematodes (moderately weak nematodes) (22). Initial kills of nematodes are related directly to fumigant vapor pressure. The experience in Louisiana has been that D-D mixture is generally more effective in reducing nematode populations in "kill samples" than Dowfume W-85. Anderson (2) found D-D mixture, Dowfume W-85 and Nemagon effective in that order against *Rotylenchulus reniformis*. D-D mixture has been more effective against cyst nematodes (1, 6, 16) than Dowfume preparations of lower vapor pressures.

The population trends of Louisiana *Trichodorus* species in control plots and their tendency to rise to abnormal population levels in fumigated plots suggests that their strong recovery depends on a rapid reproductive rate and a suppression of their natural enemies (25, 26). Behavior of the suspected plant parasites is entirely different. Here, the initial sample populations in control plots are high and only slightly lower in fumigated plots. Three factors appear implicated in their response to fumigation: (1) presence of a resistant egg stage, (2) presence of food soon after fumigation and (3) the tendency of populations to escape the action of low vapor pressure fumigants. This is illustrated by the low effectiveness of Nemagon against these nematodes. Populations apparently reached their highest peaks before the fumigant had diffused throughout the soil; they were in low numbers in both control and fumigated plots when Nemagon reached high levels of effectiveness (14).

SUMMARY

A series of 21 soil fumigation experiments were conducted in 1955-56 in Louisiana to investigate the occurrence and activities of plant parasitic nematodes on important crop plants. Fifteen of these were selected for extensive statistical analysis on the basis of effectiveness of fumigation and occurrence of relatively high numbers of species of *Pratylenchus, Trichodorus* and *Tylenchorhynchus.*

Supplemental statistical analyses indicated that methods of sampling, extraction and enumeration of the nematodes were adequate for distinguishing population trends and reactions to fumigants. Parallel statistical studies demonstrated that square root and logarithmic transformations of nematode data were generally equivalent.

Nematode genera occurring most commonly in the experiments were *Pratylenchus, Trichodorus, Tylenchorhynchus, Xiphinema, Hoplolaimus* and *Helicotylenchus.* The most common species were *Tylenchorhynchus acutus* Allen 1955, *Hoplolaimus coronatus* Cobb, 1923 and *Xiphinema americanum* Cobb 1913. The suspected plant parasitic nematodes *Tylenchus* species, *Psilenchus* species and *Ditylenchus intermedius* (deMan 1880) Filipjev 1936 were found in virtually all experiments. The distribution of commonly occurring species was independent of soil types.

Statistical analyses of populations of species of *Pratylenchus, Trichodorus* and *Tylenchorhynchus* showed that significant intraseasonal (short cycle, 4-6 week) fluctuations occurred in 41.5 per cent of the analyses. Singificant reductions of the same populations throughout the growing season, by fumigants, occurred in 55.4 per cent of the analyses.

The results suggested that individual and mixed species of plant parasitic and suspected plant parasitic nematodes in the different experiments exhibited population trends and reactions to common soil fumigants, which were characteristic of the genus.

Pratylenchus species increased in numbers during the crop season and exhibited moderate intraseasonal fluctuations and recovery from soil fumigation. *Trichodorus* species also increased in numbers during the crop season and displayed strong intraseasonal fluctuations and recovery from soil fumigation. There were indications of abnormal build-up of *Trichodorus* species in fumigated plots. *Tylenchorhynchus* species were particularly sensitive to external environmental influences and weak in recovery from soil fumigation. The common occurrence of intraseasonal fluctuations tended to obscure population increases during the crop season. Fluctuations in populations of these organisms in 1955 were correlated with soil moisture changes produced by intermittent periods of rainfall and flooding. Populations of the suspected plant parasites *Tylenchus* species and *Psilenchus* species exhibited gradual declines during the crop season and, along with *D. intermedius,* were relatively unaffected by soil fumigation.

Fumigants in descending order of effectiveness throughout the crop season were Dowfume MC-2, Nemagon, Dowfume W-85 and D-D mixture. With the exception of Dowfume MC-2, the relative effectiveness of fumigants against nematodes was related inversely to their vapor pressure. The interpretation of fumigant-nematode interactions has been simplified by the introduction and elucidation of two hitherto neglected variables: (1) fumigant vapor pressure and (2) relative population recovery of nematodes after fumigation.

LITERATURE CITED

1. ALLEN, M. W., AND D. J. RASKI. 1950. The effect of soil type on the dispersion of soil fumigants. Phytopath. 40: 1043-1053.
2. ANDERSON, E. J. 1956. Comparison of initial kills and subsequent increase of nematode populations following soil fumigation (Abs.) Phytopath. 46: 634.
3. ATKINS, J. G., M. J. FIELDING AND J. P. HOLLIS. 1955. Parasitic or suspected plant parasitic nematodes found in rice soils from Texas and Louisiana. Plant Disease Reporter 39: 221-222.
4. BIRCHFIELD, W., AND W. J. MARTIN. 1956. Pathogenicity on sugarcane and host plant studies of a species of Tylenchorhynchus. Phytopath. 46: 272-280.
5. CHRISTIE, J. R., AND V. G. PERRY. 1951. Removing nematodes from the soil. Proc. Helminthol. Soc. of Wash. D. C. 18: 106-108.
6. ENDO, B. Y., AND J. N. SASSER. 1957. The effectiveness of various soil fumigants for control of the soybean cyst nematode. (Abs.) Phytopath. 47: 9.

7. FIELDING, M. J., AND J. P. HOLLIS. 1956. Occurrence of plant parasitic nematodes in Louisiana soils. Plant Disease Reporter 40: 403-405.
8. GOHEEN, A. C., AND C. F. WILLIAMS. 1955. Seasonal fluctuations in the population of meadow nematodes in the roots of cultivated brambles in North Carolina. Plant Disease Reporter 39: 904-905.
9. GRAHAM, T. W. 1951. Nematode root rot of tobacco and other plants. South Carolina Agr. Exp. Sta. Bul. 390. 25 pp.
10. GRAHAM, T. W., AND Q. L. HOLDEMAN. 1953. The sting nematode Belonolaimus gracilis Steiner: a parasite on cotton and other crops in South Carolina. Phytopath. 43: 434-439.
11. HANSBROUGH, T., IN COOPERATION WITH J. P. HOLLIS AND M. J. FIELDING. 1956. Soil fumigation for the control of nematodes and the effect of nematodes on the survival, growth and development of loblolly pine seedlings. La. Agr. Exp. Sta. progress rpt. on project 888. Mimeographed, 5 pp.
12. HOLDEMAN, Q. L. 1956. Effectiveness of ethylene dibromide, D-D and Nemagon in controlling the sting nematode on sandy soils in South Carolina. (Abs.) Phytopath. 46: 15.
13. HOLLIS, J. P., AND TITUS JOHNSTON. 1957. Microbiological reduction of nematode populations in water-saturated soils. (Abs.) Phytopath. 47: 16.
14. ICHIKAWA, S. T., J. D. GILPATRICK AND C. W. McBETH. 1955. Soil diffusion pattern of 1,2-dibromo-3-chloropropane. Phytopath. 45: 576-578.
15. JOHNSTON, T. 1957. Reduction of nematode populations at various moisture levels. Paper read at Ann. Meet. La. Acad. Sci. April 26, 1957.
16. LEAR, B., W. F. MAI, J. FELDMESSER AND F. J. SPRUYT. 1952. Soil fumigation experiments on Long Island, New York, to control golden nematode of potatoes. Phytopath. 42: 193-196.
17. MARTIN, W. J., AND W. BIRCHFIELD. 1955. Notes on plant parasitic nematodes in Louisiana. Plant Disease Reporter 39: 3-4.
18. McBETH, C. W. 1957. Personal communication, (March).
19. MICOLETZKY, H. 1921. Die Freilebenden Erd-Nematoden. Archiv. für Naturgeschichte 87: (8) 1-320.
20. MOUNTAIN, W. B. 1955. A method of culturing plant parasitic nematodes under sterile conditions. Proc. Helminthol. Soc. Wash., D. C. 22: 49-52.
21. NEWHALL, A. G. 1955. Disinfestation of soil by heat, flooding and fumigation. Bot. Rev. 21: 189-250.
22. NUSBAUM, C. J. 1955. Variable effects of nematocides on parasitic nematode populations in row-fumigated tobacco plots. (Abs.) Phytopath. 45: 349.

23. OAKES, J. Y., C. N. BOLLICH, D. R. MELVILLE, M. J. FIELDING AND J. P. HOLLIS. 1956. A preliminary report on soil fumigation for control of parasitic nematodes on corn at Curtis, Louisiana. Plant Disease Reporter 40: 853-854.

24. OVERGAARD NIELSEN, C. 1949. Studies on the soil microfauna II. The soil inhabiting nematodes. Natura Jutlandica 2: 1-131 + a suppl. of primary tables.

25. PERRY, V. G. 1952. Soil fumigation for the control of plant parasitic nematodes. Proc. Soil Sci. Soc. of Florida 12: 40-47.

26. PERRY, V. G. 1953. Return of nematodes following fumigation of Florida soils. Proc. Florida State Hort. Soc. 66: 112-114.

27. RIGGS, R. D., D. A. SLACK AND J. P. FULTON. 1956. Meadow nematode and its relation to decline of strawberry plants in Arkansas. (Abs.) Phytopath. 46: 24.

28. SASSER, J. N., AND C. J. NUSBAUM. 1955. Seasonal fluctuations and host specificity of root-knot nematode populations in two-year tobacco rotation plots. Phytopath. 54: 540-545.

29. SEIDENSCHWARZ, L. 1923. Jahreszyklus freilebender Erdnematoden einer Tiroler Alpenwiese. Arb. Inst. Univ. Innsbruck. 1: 37-71.

30. WEHUNT, E. J. 1957. Population trends of nematodes associated with white clover in Louisiana. (Abs.) Phytopath. 47: 36.

31. WILCOX, G. E., M. J. FIELDING, J. P. HOLLIS AND D. M. JOHNS. 1956. The nematocidal effect of soil fumigation on corn production. Research In Agriculture. Ann. Rept. La. Agr. Exp. Sta. 1954-55. p. 203.

32. WILCOX, G. E., M. J. FIELDING, J. P. HOLLIS AND D. M. JOHNS. 1956. Nematode control in oat and sorgo production, Research In Agriculture. Ann. Rept. La. Agr. Exp. Sta. 1954-55. p. 204.

LA
630.7
L93b

Bulletin No. 516 May 1958

Minor Mineral Elements and Other Nutrients On Forest Ranges In Central Louisiana

By Don A. Duncan and E. A. Epps, Jr.

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

In Cooperation With
Southern Forest Experiment Station, Forest Service
U. S. Department of Agriculture

TABLE OF CONTENTS

The Forage on Forest Range 3
How the Problem was Studied 5
Minor Mineral Elements are Adequate During Spring and Summer 7
Some Major Nutrients are Adequate, Others are Deficient 10
Summary 16
Literature Cited 17

ACKNOWLEDGMENTS

The investigations reported here were conducted by the Forest Service, U. S. Department of Agriculture, in cooperation with the Louisiana Agricultural Experiment Station.

The authors offer their thanks to:

L. B. Whitaker, Alexandria Research Center, Southern Forest Experiment Station, for making most of the forage collections; Frances Bonner and Hugh C. Austin, Jr., Feed and Fertilizer Laboratory, Louisiana Agricultural Experiment Station, for analyzing the forage samples.

ON THE COVER

This herd of Louisiana range cattle grazes native forage yearlong. Under a well-balanced management system which includes supplements of protein, phosphorus, and salt, but no minor elements, calf crops have averaged 80 percent, with calves weighing over 425 pounds at 7 months of age.

MINOR MINERAL ELEMENTS AND OTHER NUTRIENTS ON FOREST RANGES IN CENTRAL LOUISIANA

Don A. Duncan and E. A. Epps, Jr.[1]

The primary purpose of the study described in this bulletin was to determine the amounts of several minor mineral elements in four important forage species native to the longleaf pine-bluestem ranges of Louisiana (Fig. 1).

The elements were cobalt, iron, copper, manganese, zinc, molybdenum, magnesium, and sulphur. Although these so-called trace elements are needed only in very small quantities, they greatly influence the vigor, growth, and reproduction of livestock. Their absence or deficiency can severely limit beef production, even when major diet items like crude protein, phosphorus, calcium, and salt are adequate.

Longleaf pine needles were also analyzed to see if their lack or abundance of minor minerals might explain the frequent grazing of this pine species. Analyses of major mineral elements and crude protein were included to substantiate previous investigations and obtain additional information on these vital items.

THE FORAGE ON FOREST RANGE

Most of the upland native range in central and southwestern Louisiana is on cutover longleaf pine land. Much of this land is completely open or lightly stocked with second-growth pines and scattered hardwoods. Generally pinehill or slender bluestem is the key forage species. Pinehill bluestem predominates in the gently rolling hills of the central areas; slender bluestem, in the flatwoods of southwest Louisiana. Other grasses, especially dropseeds, panicums, paspalums, and muhlys, are also important. In addition, cattle graze various native legumes and forbs. On these upland ranges, browse plants contribute little to the cattle diet (*4*)[2].

Forage growth is directly influenced by species, soil, amount of tree cover, rainfall, and other factors. Annual production often exceeds one ton (air-dry) per acre. Most growth occurs in April, May, and June. This growth is relatively nutritious and is grazed readily. After June, dry weather usually sets in, and vegetative growth slows down as the plants mature. Rain sometimes stimulates a surge of vegetative growth in September, but otherwise most of the late growth is in flower stalks, which are grazed lightly.

---

[1] Don A. Duncan, Range Conservationist, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture; E. A. Epps, Jr., Chief Chemist, Feeds and Fertilizer Laboratory, Louisiana Agricultural Experiment Station.

[2] Italic numbers in parentheses refer to Literature Cited, Page 17.

Nutritional deficiencies of the native forage have long troubled cattle owners whose herds grazed yearlong on forest range. Earlier research (*4*, *5*, *8*) was confined to analyses for major mineral elements and other nutrients. This study is the first to deal with the minor elements.

In brief, the earlier studies showed that crude protein in native forage is highest from late March, when growth begins, through

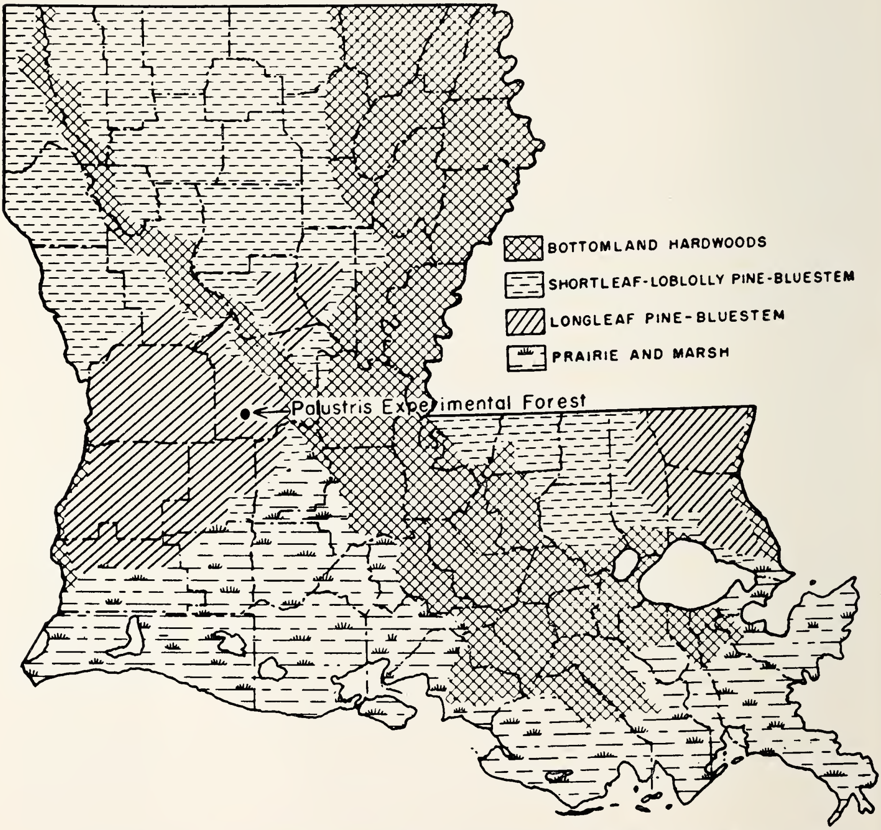

BOTTOMLAND HARDWOODS
SHORTLEAF-LOBLOLLY PINE-BLUESTEM
LONGLEAF PINE-BLUESTEM
PRAIRIE AND MARSH
Palustris Experimental Forest

Figure 1.—Forage types in Louisiana. Although this bulletin deals specifically with the longleaf pine-bluestem type, the findings may apply also to the shortleaf-loblolly pine-bluestem region.

June. Starting in July, protein falls below the minimum requirement (*10*) of about 8 percent for breeding herds and gradually declines to 4 or 5 percent in December and January. Thus, seasonal protein supplements must be furnished range cattle to obtain high beef production.

Phosphorus content of most range forage varies from a high of about 0.13 percent in April to a low of 0.06 percent in midwinter. As the phosphorus content for almost the entire year is below the generally accepted minimum of 0.13 for range cattle (*3*), mineral supplements high in phosphorus are needed yearlong by range cattle.

Calcium is adequate in most forage species yearlong, and in greatest supply during the summer. Calcium supplements are not considered necessary.

These seasonal variations in protein and major minerals partially explain why cattle gain or lose weight during particular seasons of the year. For instance, during spring and early summer cattle may gain from 1 to 1½ pounds per day on native upland forage. As a general rule they barely maintain body weights during late summer and early fall. The occasional upsurge in September forage growth enables them to put on additional weight. The critical period is the fall and winter. Without supplemental feeding, some experimental herds have lost up to 25 percent of their weight from December through February.

HOW THE PROBLEM WAS STUDIED

Plants Collected

Species selected for study are common on forest ranges in central and southwestern Louisiana. The three grasses are representative of major groups; the forb is a favorite of cattle but varies in abundance.

Pinehill bluestem (*Andropogon divergens* [Hack.] Anderss. *ex*-Hitchc.) has been described (*15*) as "the most abundant and valuable forage grass in the Louisiana-east Texas longleaf pine belt." It is found both in the open and beneath pines or hardwoods. It makes up 25 to 35 percent of the forage on most ranges and is representative of the broad-leaved bluestem group, which on the average contributes over 40 percent of the cattle diet (*4*).

Slender bluestem (*Andropogon tener* [Nees] Kunth.), the most common species in the fine-leaved bluestem group, furnishes about one-fifth of the average yearlong forage supply of range cattle (*4*). Known in some localities as "wire-grass," it occurs primarily in open areas and is especially important during the spring and early summer. Under light or no grazing, it forms tough, unpalatable flower stalks earlier than most other major species, but moderate or heavy grazing lengthens its season of palatability considerably. Once mature, the plant is not preferred by cattle.

Narrowleaf panicum (*Panicum angustifolium* Ell.) was selected as typical of the large group of upland panicum grasses. The panicums constitute between 5 and 40 percent of the herbaceous vegetation on longleaf ranges (*4*). They furnish an important part of the range cattle diet in the early spring.

Swamp sunflower (*Helianthus angustifolius* L.) is probably the most heavily grazed forb on the longleaf pine-bluestem ranges (*15*). Cattle prefer it from the time growth begins in the spring until after seed heads form in late summer and fall. On any given range, therefore, its contribution to the cattle diet is more or less in direct proportion to its abundance. It is grazed very heavily even on moderately stocked ranges.

Pine needles are a minor constituent of cattle diet. Frequently, however, browsing severely damages longleaf pine (*Pinus palustris* Mill.) seedlings.

Field Methods

Hundred-gram samples (air-dry weight) of the five species were collected in the early-leaf, full-leaf, and mature green-leaf stages of development. In the early- and full-leaf stages, the plants consisted almost entirely of green leaves. Samples of the mature green-leaf stage contained some immature flower stalks. The sampling area was typical cutover longleaf pine range on the Palustris Experimental Forest in southern Rapides Parish. The land has never been cultivated or fertilized. Table 1 shows the dates of collection.

Plant specimens were taken from two distinct soil types common in central and southwestern Louisiana. The first is Beauregard very fine sandy loam, a deep, medium-textured soil with very slow internal drainage. On the study area, the slope ranges from 1 to 3 percent and the surface soil is about 4 inches deep. The second is Ruston fine sandy loam, a deep, medium-textured, and moderately permeable soil with good internal drainage. Slope varies from 8 to 12 percent and depth of the surface soil is about 5 inches.

Laboratory Methods

Chemical analyses of the forage samples were made by the Feeds and Fertilizer Laboratory, Louisiana Agricultural Experiment Station.

Analyses for crude protein were made according to procedures of the Association of Official Agricultural Chemists (*2*). The procedures of Parks et al. (*23*) were followed for the other elements, except that potassium, calcium, and magnesium were determined by flame photometry.

MINOR MINERAL ELEMENTS ARE ADEQUATE DURING SPRING AND SUMMER

The analyses indicated that, according to available standards, the species sampled contain adequate quantities of all minor mineral elements during spring and summer. Similar findings have been reported from other states, and deficiencies seem to be the exception (*1*, *11*, *13*, *21*, *22*, *28*). Further analyses are needed to determine the mineral content of these plants during fall and winter. It would appear, however, that no serious deficiencies exist at any season. Herd tests in central Louisiana, started after the samples for minor mineral elements were collected, show that very good calf crops can be obtained economically from herds grazing yearlong on forest range without minor-mineral supplements (7). Thus on Louisiana longleaf pine range supplements of minor minerals seem to be an unnecessary expense, and some may even be harmful to the animals (*11*, *17*, *30*).

The pine needles contained all the minor elements found in the other plants, but the quantities were not sufficient to explain why cattle sometimes browse the pines.

Soil type had no important influence on the mineral content of the species sampled. Data for the two types are therefore combined, both in Table 1 and in the following discussion.

Cobalt

Plants analyzed in this study contained from 0.12 to 0.88 parts per million of cobalt (Table 1). Seasonal fluctuations were evident: all plants possessed liberal amounts in early leaf and mature stages but relatively low concentrations at full leaf.

In other sections of the country, cobalt deficiencies have occurred where forage contained only 0.01 to 0.07 p.p.m. (*10*, *18*, *29*, *30*). Symptoms were loss of appetite, scaliness of skin, listlessness, and heavy loss of weight. But where forage contained 0.07 to 0.30 p.p.m. no adverse effects were noted (*10*, *29*, *30*).

At no time did any of the plants in this study fall below 0.12 p.p.m. Therefore, mineral supplements containing cobalt are not necessary for cattle grazing during spring and summer on longleaf

TABLE 1.—Mineral and Crude Protein Content of Three Grasses, One Forb, and Pine Needles.

Species and maturity stage	Date of collection	Minor elements								Major elements			Crude protein
		Cobalt	Iron	Copper	Manganese	Zinc	Molybdenum	Magnesium	Sulphur	Potassium	Calcium	Phosphorus	
		P.p.m	*P.p.m*	*P.p.m*	*P.p.m*	*P.p.m*	*P.p.m*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Pinehill bluestem													
Early leaf	3/54	0.54	132	44.0	376	12.2	[2]	0.47	0.77	1.94	0.29	0.13	11.6
Full leaf	6/54	.13	100	39.0	40[1]	1.0	[2]	.42	.45	1.06	.36	.07	6.5[1]
Mature green	8/54	.24	70	22.5	102	46.8	0.12	.40	.42	.94	.52	.06	4.8
Slender bluestem													
Early leaf	4/54	.50	186	51.5	492	12.2	[2]	.55	.12	1.42	.36	.12	10.1
Full leaf	6/54	.36	134	43.0	560	8.4	[2]	.54	.09	1.04	.39	.07	6.2
Mature green	8/54	.60	78	32.5	486	12.0	[2]	.43	.06	.90	.21[1]	.06	5.0
Narrowleaf panicum													
Early leaf	3/54	.68	172	38.0	324	9.1	[2]	.66	.23	2.68	.20	.12	15.4
Full Leaf	4/54	.29	80	49.0	220	1.6	[2]	.57	.19	1.86	.32	.10	12.2
Mature green	8/54	.38	112	32.5	190	33.4	.13	.41	.11	.74	.32	.04	6.0
Swamp sunflower													
Early leaf	3/54	.48	324[1]	54.0	414	13.4	[2]	1.28	.26	5.00	1.32	.18	17.5
Full leaf	6/54	.12	230	47.5	560	2.5	[2]	1.18	.19	3.49	1.64	.12	12.3
Mature green	8/54	.41	136	44.6	570	47.6	.07	1.26	.21	2.83	2.34	.09	11.0
Longleaf pine													
Early leaf	6/54	.88	89	35.5	190	12.5	[2]	.33	.06	.86	.20	.10	6.6
Full leaf	8/54	.12	59	27.8	119	39.9	.14	.33	.04	.70	.24	.09	6.2
Mature green	10/54	.73	162	32.8	346	12.4	.10	.39	.08	.60	.33	.08	7.0

[1] Data from one sample.
[2] Less than 0.06 p.p.m.

pine-bluestem ranges of Louisiana. In fact, precautions should be taken against indiscriminate use of cobalt in supplements, because excessive quantities are harmful to animals (*30*).

Iron

Iron is essential to the formation of blood, but no instance of iron shortage has been reported for grazing cattle. As little as 25 to 50 p.p.m. has been found adequate (*17*), and species in this study contained more than 50 p.p.m. at all stages of development.

Copper

The copper content of plants in this study ranged from 22 to 54 p.p.m. With one exception the concentration was highest in the early leaf stage and lowest in the mature stage. These values are somewhat larger than those reported for forage in several other areas (*12*, *19*, *24*, *25*).

Exact animal requirements are difficult to establish, but an average of various findings (*10*, *17*, *30*) may be described as follows:

"Deficient" forage	1-4 p.p.m.
"Healthy" forage	5-8 p.p.m.
"Curative" forage	7-30 p.p.m.

Although deficiencies have been reported in forage and feeds produced in certain areas of this country (*10*, *16*, *17*), the native forage in central Louisiana contains ample copper. Supplementation during spring and summer should be discouraged, for excessive quantities may interfere with rumen activity (*30*).

Manganese

Manganese deficiencies in native forage are rare. Species in this study ranged from 40 to 570 p.p.m., with no consistent seasonal trends. This is well above the 6 to 20 p.p.m. found necessary to keep animals healthy (*10*, *16*).

Manganese may warrant concern because forage with 500 p.p.m. has been reported to cause grass tetany (*30*). At certain stages, slender bluestem and swamp sunflower exceed this amount. Of course, cattle on forest range eat a variety of plants, many of which have a lower manganese content. No known cases of grass tetany or other ill effects of excess manganese have been reported on Louisiana's forest ranges.

Zinc

The role of zinc in animal nutrition is not thoroughly understood, but most authorities agree that small quantities are necessary for normal growth. The species tested contained from 1 to 40 p.p.m.;

this is presumed to be sufficient, though animal requirements have not been established.

Molybdenum

Molybdenum is another essential element for which cattle requirements are unknown. A survey of literature failed to reveal any cases of molybdenum deficiencies in forages or rations. Too much is likely to cause copper and cobalt deficiencies (*10*, *16*). A serious condition known as "teartness" developed in cattle fed rations containing 8 to 12 p.p.m., and several California pastures have produced forage with harmful amounts (*29*, *30*). Generally, pastures with 2 p.p.m. or less are considered safe. Meager data in this study indicate that native forage on Louisiana longleaf ranges has sufficient, safe quantities of molybdenum.

Magnesium

Plants analyzed contained from 0.33 to 1.28 percent of magnesium. The magnesium content of all grasses decreased as the plants matured. Swamp sunflower had the most and longleaf pine needles the least.

As all plants at all stages contained considerably more than the minimum requirement of 0.04 to 0.07 percent (*17*), and as magnesium shortages have not been reported in natural forage, there is no reason to suspect a lack in native forage.

Sulphur

The general trend in this study was for sulphur content to decrease with plant maturity, but most authorities agree that sulphur is ample in natural forage and no shortage is suspected in the forest ranges of Louisiana.

SOME MAJOR NUTRIENTS ARE ADEQUATE, OTHERS ARE DEFICIENT

While this study showed that minor elements are in good supply, it corroborated previous findings that phosphorus and crude protein are often inadequate. Calcium is generally ample. Potassium, a major nutrient not previously studied on Louisiana forest ranges, was also found to be plentiful.

For practical purposes, then, it seems clear that the main dietary deficiencies of Louisiana range forage are in phosphorus and protein. When these nutrients are supplied, and the animals are given salt, water, and care, range cattle can produce excellent beef crops.

Potassium Proves Ample

Cattle probably require between 0.15 to 0.20 percent of potassium in their diet (*17*). Most feeds and forage provide considerably more than this, but no values for longleaf pine range were on record. The species sampled were found to contain from 0.60 to 5.00 percent. Amounts generally declined as the season advanced, but even in the mature leaf all plants had several times more than the minimum required by cattle. Swamp sunflower had appreciably more than the other species. Louisiana range cattle are thus getting more potassium than they need, but the surplus probably does no harm.

Calcium Is Adequate

Calcium is one of the most important minerals for bone-building, growth, and reproduction. Fast-gaining young animals and pregnant and lactating cows require more than dry cows. Most authorities agree that 0.20 to 0.24 is desirable for breeding herds.

As in previous studies (*4*, *5*, *8*) most of the plants sampled contained more than 0.20 percent. In general, the proportion increased as the plants matured (Fig. 2). Swamp sunflower was exceptionally high in calcium at all stages of development.

Specific calcium supplements are not justified for cattle on longleaf pine ranges in Louisiana. This is especially true when bonemeal is furnished as a phosphorus supplement, because it contains 32 percent calcium in addition to 15 percent phosphorus (*20*).

Phosphorus Is Deficient Yearlong

The basic mineral problem in Louisiana's forest range is a yearlong deficiency of phosphorus.

The phosphorus content of native range forage in Louisiana, like that of most native forage throughout the Gulf Coast, is consistently low (*4*, *5*, *8*, *9*, *26*). The symptoms of a phosphorus deficiency are severe weight losses, excessive mortality, and a condition resulting in stiff joints which is commonly called "stiff disease," and "creeps." This mineral is highly important to animal reproduction and perhaps the most serious effect of a deficiency is the low calf crop. In several areas where the forage was low in phosphorus, supplements of this mineral have increased calf production remarkably (*3*, *26*, *27*).

Forage containing 0.12 to 0.14 percent phosphorus is ordinarily adequate for dry cows (*14*, *16*), but about 0.18 percent is needed for fast gains, and for pregnant and lactating cows (*10*, *16*). Since cows in any high-producing herd are pregnant or lactating for the

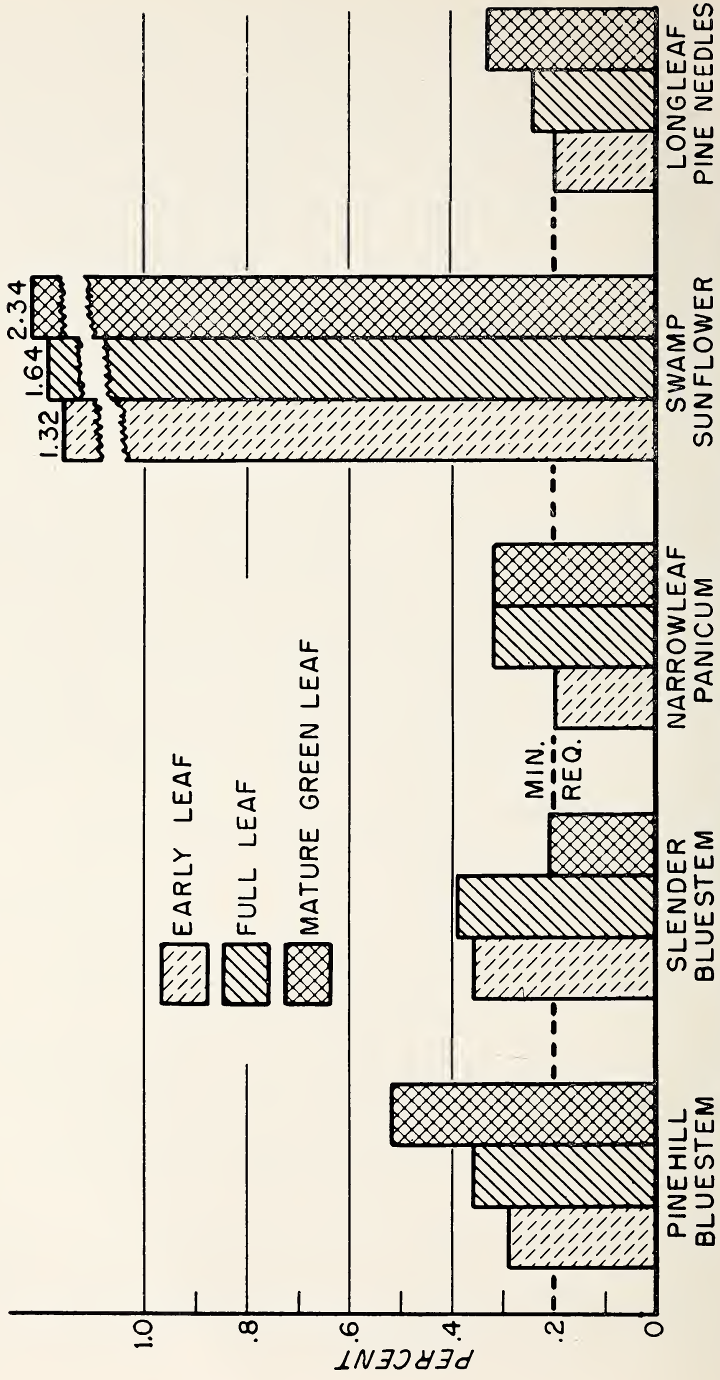


Figure 2. Calcium was adequate for all species in all stages of leaf development.

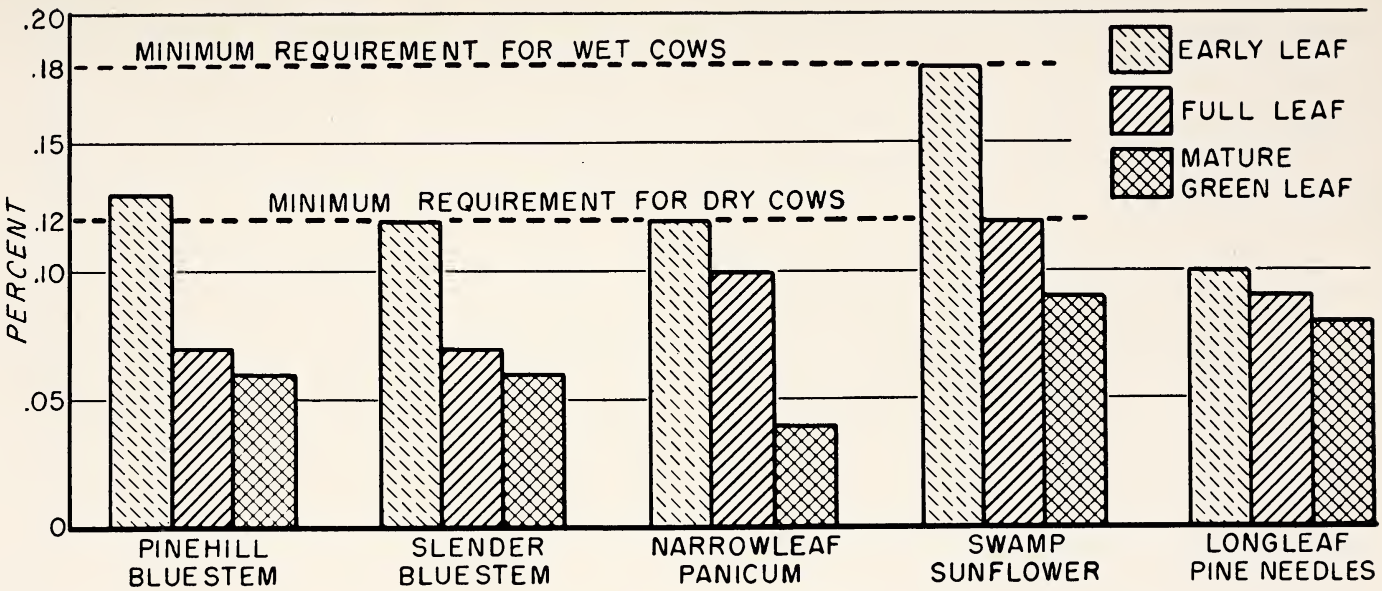


Figure 3. Phosphorus was deficient at virtually all growth stages.

entire year, the 0.18 percent level should be considered necessary for all practical purposes.

The grasses analyzed in this study contained only about 0.12 percent phosphorus during the early leaf stage, and were even more critically deficient in the other stages (Fig. 3). Swamp sunflower was highest in phosphorus among species tested and contained sufficient amounts in the early leaf stage. Longleaf pine needles were deficient in all stages, but in the mature leaf had more than any of the grasses. These results are very similar to previous findings (*4*, *5*, *8*), and show the necessity of yearlong phosphorus supplements for high-producing range cattle in Louisiana.

Crude Protein Is Seasonally Deficient

This study confirmed Campbell and Cassady's findings that crude protein is deficient in native range forage at some seasons (*4*). Dry cows need about 8 percent of crude protein in their diet and lactating cows 11 percent. Swamp sunflower met these requirements at all growth stages (Fig. 4). The bluestems were above 8 percent crude protein only during the early leaf stage, whereas narrowleaf panicum retained fairly high amounts through the full leaf stage. Longleaf pine needles were deficient at all stages, but at the mature leaf stage had considerably more than either of the bluestems.

Beef herds grazing yearlong on forest range need a protein supplement for 6 to 8 months of each year. This is primarily because the bluestems, which make up the major portion of the forage, are deficient after late spring or early summer. The panicums and forbs, though eagerly grazed, generally are not plentiful enough to offset the protein deficiency of the bluestems even in summer.

The exact periods to supplement crude protein in the most economical quantities are yet to be determined.

Herd Tests Show Value of Protein and Phosphorus Supplements

Common range cattle have grazed longleaf pine range on the Palustris Experimental Forest for many years. One group of cattle, for several years prior to 1954, was given just enough cottonseed cake to keep the animals alive during the winter. Beef production was low, with calf crops averaging about 50 percent and calves seldom weighing more than 300 pounds in fall. This performance was about average for open-range herds in this state (*4*, *6*).

Beginning in 1954, one of the herds was given adequate supplements of protein and phosphorus. The phosphorus was kept before the animals all year and the protein was fed as soon as the

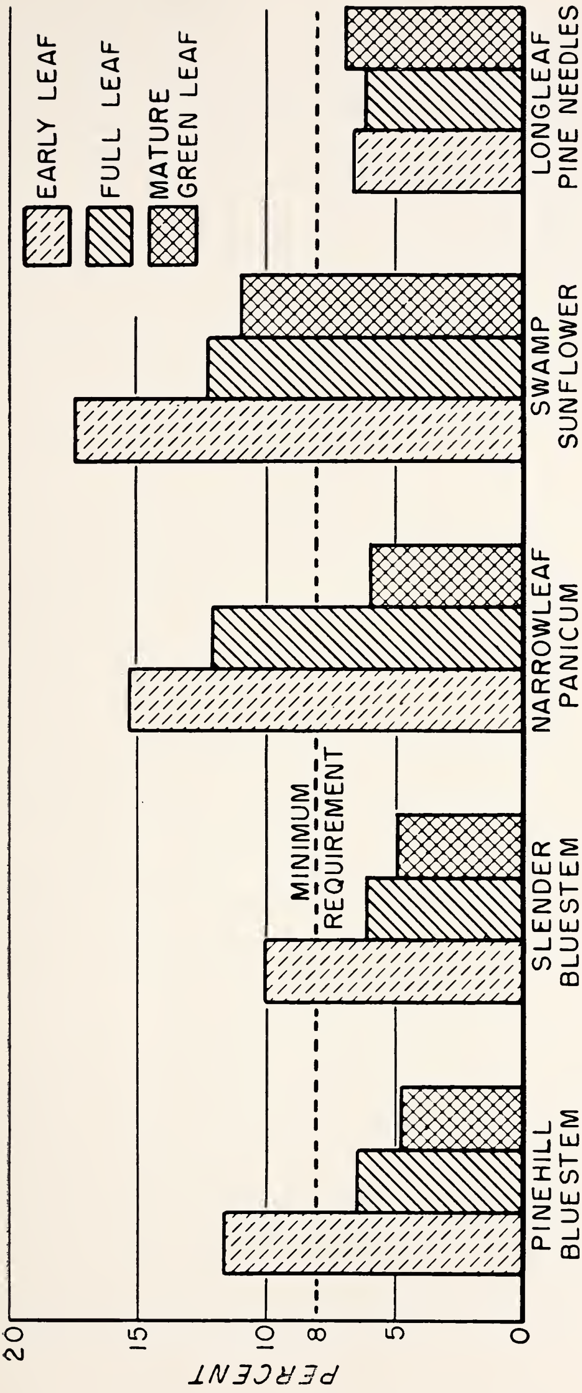


Figure 4. Crude protein is seasonally deficient.

range forage dropped below minimum for this nutrient. Loose salt was also furnished yearlong.

The animals responded rapidly; beef production was more than doubled. Calf crops now average more than 80 percent, with calves weighing well over 400 pounds at 7 months of age. The cattle still graze yearlong on native range, and no minor mineral supplements have been used.

The performance of this herd is in line with the conclusions from the laboratory tests reported in this bulletin—that the primary deficiencies in the forage on longleaf pine range are in crude protein and phosphorus, and that other nutrients, both major and minor, are adequate during spring and summer.

SUMMARY

The study was initiated to determine the amounts of several minor mineral elements in four important forage species native to the longleaf pine-bluestem ranges of Louisiana. Secondary purposes were to see if lack of or abundance of certain elements caused frequent grazing of pine needles, and to substantiate previous findings on the amounts of major elements and crude protein in native forage.

Samples of three grasses (pinehill bluestem, slender bluestem, and narrowleaf panicum), one forb (swamp sunflower), and longleaf pine needles were collected at three stages of development on two distinct soil types near Alexandria, Louisiana. All species sampled are common on the upland forest ranges of central and southwestern Louisiana, and with the exception of pine needles are representative of large groups of forage plants. Samples were analyzed by the Feeds and Fertilizer Laboratory, Louisiana Agricultural Experiment Station.

No important consistent differences were found in nutritive or mineral values of the forage species from the two soil types.

No shortages of cobalt, iron, copper, manganese, zinc, molybdenum, magnesium, or sulphur were found in any of the species at any stage of development. It is quite evident, therefore, that supplementation of minor mineral elements during spring and summer is an unnecessary expense. It may also be hazardous because excessive quantities of certain minerals are harmful.

The nutrient analysis of the pine needles revealed no reasons why cattle sometimes browse these trees excessively.

All forage species contain adequate calcium and potassium at all stages of development.

In most species phosphorus was deficient at all stages of development. A high-phosphorus supplement should be furnished range cattle yearlong.

Generally, the grasses on forest ranges contain inadequate crude protein for breeding herds from midsummer until early spring. A protein supplement should be furnished during the deficient period.

Current practical herd tests in central Louisiana, in which range cattle are given seasonal protein supplements and yearlong bonemeal and salt, indicate that beef production of common cattle grazing yearlong on forest range can be greatly increased without use of minor-mineral supplements.

LITERATURE CITED

1. ARCHIBALD, J. G., 1948.
   Minerals for dairy cattle. Univ. Mass. Ext. Serv. Leaflet 236 (rev.), 8 pp.
2. ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, 1950.
   Official methods of analysis. Ed. 7, 910 pp. Washington, D. C.
3. BLACK, W. H., TASH, L. H., JONES, J. M., and KLEBERG, R. J., JR., 1949.
   Comparison of methods of supplying phosphorus to range cattle. U. S. Department Agr. Tech. Bul. 981, 22 pp., illus.
4. CAMPBELL, R. S.. and CASSADY, J. T., 1951.
   Grazing values for cattle on pine forest ranges in Louisiana. La. Agr. Expt. Sta. Bul. 452, 31 pp., illus.
5. ______________________, EPPS, E. A., JR., MORELAND, C. C., FARR, J. L., and BONNER, F., 1954.
   Nutritive values of native plants on forest range in central Louisiana. La. Agr. Expt. Sta. Bul. 488, 18 pp., illus.
6. ______________________, and RHODES, R. R., 1944.
   Forest grazing in relation to beef cattle production in Louisiana. La. Agr. Expt. Sta. Bul. 380, 43 pp., illus.
7. CASSADY, J. T., and WHITAKER, L. B., 1957.
   Supplemental feeding and management of beef cattle on forest range in Louisiana. Soc. Amer. Foresters Proc. 1956: 52-54.
8. FRAPS, G. S., and FUDGE, J. F., 1940.
   The chemical composition of forage grasses of the east Texas timber country. Texas Agr. Expt. Sta. Bul. 582, 35 pp.
9. FUDGE, J. F., and FRAPS, G. S., 1944.
   The chemical composition of forage grasses from the Gulf Coast prairie as related to soils and to requirements of range cattle. Texas Agr. Expt. Sta. Bul. 644, 39 pp.

10. GUILBERT, H. R., GERLAUGH, PAUL, and MADSEN, L. L., 1950.
Recommended nutrient allowances for beef cattle, (Rev.) Nat. Res. Council, 37 pp., illus.
11. HAAG, J. R., 1951.
Minerals for livestock. Ore. Agr. Expt. Sta. Bul. 503, 12 pp., illus.
12. HALLS, L. K., KNOX, F. E., and LAZAR, V. A., 1957.
Common browse plants of the Georgia Coastal Plain: Their chemical composition and contribution to cattle diet. U. S. Forest Serv. Southeast. Forest Expt. Sta. Paper 75, 18 pp., illus.
13. KENTUCKY AGRICULTURAL EXTENSION DIVISION, 1953.
Minerals for livestock. Ky. Agr. Ext. Div. Cir. 360 (rev.), 15 pp., illus.
14. KNOX, J. H., BENNER, J. W., and WATKINS, W. E., 1941.
Seasonal calcium and phosphorus requirement of range cattle, as shown by blood analyses. N. Mex. Agr. Expt. Sta. Bul. 282, 28 pp., illus.
15. LANGDON, O. G., BOMHARD, M. L., and CASSADY, J. T., 1952.
Field book of forage plants on longleaf pine-bluestem ranges. U. S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 127, 117 pp., illus.
16. LOOSLI, J. K., BECKER, R. B., HUFFMAN, C. F., PHILLIPS, P. H., and SHAW, J. C., 1956.
Nutrient requirements for dairy cattle. Nat. Res. Council Pub. 464, 30 pp., illus.
17. MITCHELL, H. H., 1955.
Minerals in livestock feeding. Ill. Agr. Expt. Sta. Cir. 688 (rev.), 16 pp., illus.
18. MITCHELL, J. H., 1951.
Cobalt content of pasture plants and feeding materials. S. C. Agr. Expt. Sta. Bul. 391, 10 pp.
19. ——————————, 1955.
Some mineral nutrients found in South Carolina plants and the effect of fertilizer on the mineral content of the plants. S. C. Agr. Expt. Sta. Cir. 96, 15 pp.
20. MORRISON, F. B., 1939.
Feeds and feeding. Ed. 20, 1050 pp., illus. Ithaca, N. Y., illus.
21. NELSON, A. B., MACVICAR, R. W., CAMPBELL, W. D., and ROSS, O. B., 1955.
Supplements of different protein and vitamin-mineral content for wintering bred yearling heifers. Okla. Agr. Expt. Sta. Bul. B-460, 11 pp.
22. ——————————, TOTUSEK, R., POPE, L. S., CALLUP, W. D., and MACVICAR, R. W., 1956.
Feeding trace minerals to beef cattle in Oklahoma. Okla. Agr. Expt. Sta. Bul. B-470, 12 pp.
23. PARKS, R. Q., HOOD, S. L., HURWITZ, C., and ELLIS, G. H., 1943.
Quantitative chemical microdetermination of twelve elements in plant tissue. Ind. and Engin. Chem., Anal. Ed. 15: 527-533, illus.
24. PRICE, N. O., LINKOUS, W. N., and ENGEL, R. W., 1955.
Minor mineral elements content of forage plants from the Coastal Plain region of Virginia. Va. Polytech. Inst. Agr. Expt. Sta. Tech. Bul. 123, 8 pp.

25. ______________, LINKOUS, W. N., and HILL, H. H., 1951.
The absorption of minor elements by forage crops as influenced by fertilization and soils. Va. Polytech. Inst. Agr. Expt. Sta. Tech. Bul. 117, 14 pp.

26. REYNOLDS, E. B., JONES, J. M., JONES, J. H., FUDGE, J. F., and KLEBERG, R. J., JR., 1953.
Methods of supplying phosphorus to range cattle in south Texas. Texas Agr. Expt. Sta. Bul. 773, 16 pp., illus.

27. RIDDELL, W. H., HUGHES, J. S., and FITCH, J. B., 1934.
The relation of phosphorus deficiency to the utilization of feed in dairy cattle. Kans. Agr. Expt. Sta. Tech. Bul. 36, 54 pp., illus.

28. SMITH, A. L., THOMPSON, U. D., JONES, J. H., and RIGGS, J. K., 1954.
Minerals for beef cattle. Texas Agr. Ext. Serv. B-174 (rev.), 15 pp., illus.

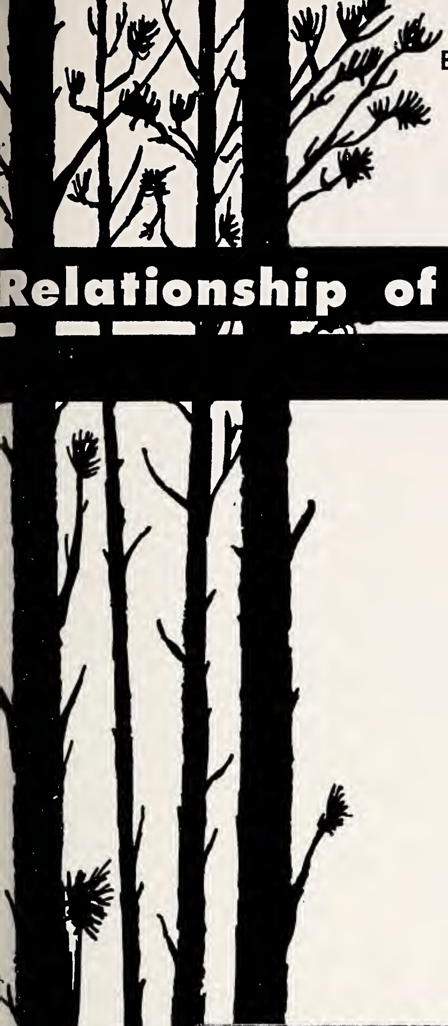
29. U. S. DEPARTMENT OF AGRICULTURE, 1957.
Soil. Agr. Yearbook 1957, 784 pp., illus.

30. VIRGINIA POLYTECHNIC INSTITUTE, AGRICULTURAL EXTENSION SERVICE, 1955.
Minerals for meat animals. Va. Polytech. Inst. Agr. Ext. Serv. Bul. 226, 27 pp., illus.

Bulletin No. 517

630.7
L93b

December 1958



Relationship of Stand Characteristics to Quality of Loblolly Pine

by William C. Hopkins

Louisiana State University
and Agricultural and
Mechanical College

Agricultural Experiment Station
Charles W. Upp, Director

TABLE OF CONTENTS

Review of Previous Work 4

Methods of Study 4

Collection and Computation of Data 9

  Basal Area Computations 10

  Volume Computations 10

  Quality Indices 10

  Plot Value 10

Analysis of Data 11

  Relationship of Certain Stand Characteristics to Pine Quality Index 12

  Relationship of Certain Stand Characteristics to Gross Plot Value 15

Discussion of Results 19

  Pine Quality Index 19

  Gross Plot Value 22

  Ideal Stand Conditions 23

Summary and Conclusions 24

Literature Cited 26

Relationship of Stand Characteristics to Quality of Loblolly Pine

William C. Hopkins*

Current management practices in the loblolly pine (*Pinus taeda* L.) belt usually include stand improvement measures designed to reduce the number of hardwoods in the stand to a minimum. There is a sound basis for such measures. Many of the hardwoods which are associated with the pine in this mixed forest are of lower quality and lower value than the pine. In fact, there is no market at all for some of them. A primary objective in the business of forestry is the production of the greatest possible volume of the most valuable species. Therefore, most of the owners and managers of the larger forest land holdings have undertaken to eliminate the hardwoods and grow only pine.

Such practices may not result in the greatest financial return from forest land because of the fact that the value, in dollars, of the timber grown on any given acre may be just as dependent upon the quality of the timber as upon the quantity. It is doubtful that second-growth stands of loblolly pine will ever produce the high quality trees which were found in the virgin forest, but there are definite possibilities of improvement of the quality of the individual tree through the use of intensive silvicultural practices. Manipulations of stand composition are within the province of the forest manager and may be of some value in improving tree quality.

Indiscriminant hardwood subjugation, as now embodied in most loblolly pine management recommendations, ignores the fact that stand composition may have a considerable effect upon the quality of the trees which are produced. Although the relative merits of pure and mixed stands have received considerable attention, both in this country and in Europe since the establishment of the profession of forestry, there has been little research which was designed specifically to shed light upon the relationships between the quality of loblolly pine lumber and the various factors which contribute to stand composition. Many questions remain unanswered.

This report summarizes the procedures and results of a study in the Florida Parishes of Louisiana which was designed to add to the knowledge of the effects of stand composition upon freedom from knots in loblolly pine lumber.

---

*School of Forestry. This bulletin is a condensation of a dissertation presented to the Faculty of the School of Forestry of Yale University in partial fulfillment of the requirements for the degree of Doctor of Forestry.

REVIEW OF PREVIOUS WORK

Weaver and Clements (1938) and Garren (1943) have stated that the pure forest of loblolly pine is usually considered a sub-climax type of vegetation which is dependent for its existence upon fire or some other catastrophic occurrence which tends to hold the hardwood species in a relatively minor position in the stand. Market demands have resulted largely in removal of the pine component. At the same time, extensive fire protection has favored the hardwoods.

Reynolds (1947), Clark and Williston (1947), Demmon (1953), and members of the staff of the Southern Forest Experiment Station (1955) have emphasized the importance of the problems generated by encroachment of low-grade hardwoods on pine lands.

Various methods of control of hardwoods on pine lands have been investigated (Peevy, 1953; Silker, 1953; Vincent, 1955; Riebold, 1955; and Owens, 1955). It now appears possible to relegate the hardwoods to a position of minor importance in southern pine stands.

Little work on stand composition-quality relationships has been done in the southern pine region. Paul (1932) found that age of the stand and the amount of hardwoods in the mixture were responsible for most of the fluctuation in value of mixed loblolly-hardwood stands. Rate of stocking was the most important factor in pure pine stands.

The effect of forest growth conditions on quality has received more attention in other regions. Tarbox and Reed (1924), Cline and Lockard (1935), Rapraeger (1939), and Foster (1953) have reported investigations in both northern and western white pine. They have concluded that density of stand, age of stand, and presence of another species in mixture are important contributors to quality.

Serious management problems arise in the loblolly pine type from the encroachment of low-quality hardwoods, but the newer techniques of control are relatively effective. However, too little is known of the growth condition-quality relationship in this type; therefore, indiscriminant hardwood removal may not be desirable. Manipulations of tree quality are well within the scope of silvicultural practice.

METHODS OF STUDY

This study had as its main objective the determination of any possible effects of certain stand conditions upon the quality of the loblolly pine component of timber stands in the Florida Parishes of Louisiana. To attain this objective, 194 temporary sample plots were established at random on four timbered areas. The location of these study areas is shown in Figure 1.

Plots were 1/5-acre in size, circular, and so located that the plot center was at least 118.7 feet from all stand boundaries. Minimum distance between plot centers was 3.6 chains. The plots were subjected to a 100 per cent inventory of all stems with a diameter at breast height of 6.0 inches or larger. In this inventory, the following information was re-

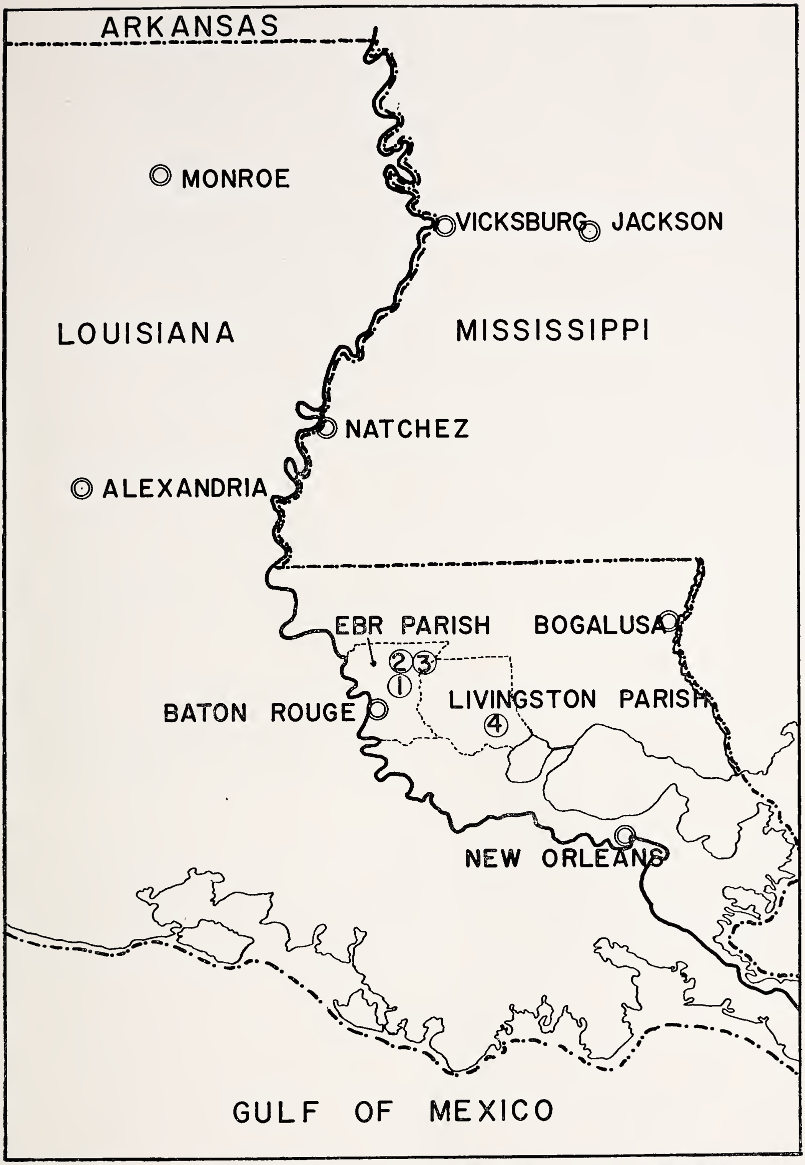
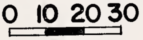


FIGURE I. GENERAL LOCATION OF STUDY AREAS

① INDIAN MOUND TRACT, ② PRIDE TRACT, ③ BAYWOOD TRACT, ④ GAYLORD TRACT

SCALE OF MILES



corded for each tree: species, diameter at breast height, merchantable length to the nearest 8-foot log, tree grade, and crown position. In addition, total age and total height were determined for 6 to 10 dominant pine trees on each plot. These figure were used to determine average age of the stand and site index (U.S.D.A., 1929).

In order to avoid, insofar as possible, any element of subjectivity, rather rigid criteria and definitions of stands, plots, limits of merchantability, tree grades, and crown position were set up. Some of these criteria are, of necessity, arbitrary, but they do assure that all data were governed by the same set of specifications. The definitions are as follows:

Stands: Plots were established only in stands where the pine component fell within a ten-year age class and where the entire stand, both pine and hardwood, was essentially single-storied. Stands were excluded which were obviously layered and multi-aged. Seedlings and saplings which were so far beneath the main crown canopy that they could not possibly affect the crowns of the main stand were disregarded in deciding whether a stand was single- or multi-storied.

Plots: Before any measurements were made, each plot was carefully examined. If residual trees of either pine or hardwood, stumps, or recent fire damage were found within the plot boundary, the plot was not used. Likewise, no measurements were made where there were no pine trees on the plot. However, if even one pine was found on the plot, measurements were made and data recorded.

Limits of Merchantability: All trees 6.0 inches in diameter at breast height or larger were tallied. The upper limit of merchantability was set at 5.0 inches in diameter inside the bark. Board-foot volumes, International ¼-inch Rule, were computed for all trees except culls.

Tree Grades: Estimates of quality of the timber on the sample plots were obtained by recording the grade of each tree. Both the pine and the hardwood grades were based upon the quality of the butt log. Three systems of grades for pine were compared before plot work was begun. Two of them were found to be inaccurate, because they were based upon the quality of the first two logs and it was not possible to estimate accurately the size and number of knots on the second log. The other system of grades, based upon the Forest Service Interim Log Grades for Southern Pine (Grosenbaugh *et al.*, 1953), was relatively easy to apply. However, it did not take into account the high quality trees of small diameter. Because it seemed desirable to record such trees separately, a revision of this system was developed to provide a special category for trees between 6 and 19 inches in diameter at breast height which were otherwise grade A. A grade-yield study of 202 trees, each graded by all four systems, revealed that the revision of the Interim Grades was the most satisfactory of the systems under consideration for the area involved. The tree quality indices for this system, obtained in the grade-yield study, are:

Tree Grade	Quality Index
A	146
B	128
B_1	120
C	101
Pulpwood	33
Cull	0

The quality index for pulpwood trees was obtained by assuming a value per standard cord equal to 16.5 per cent of the value per thousand board feet of No. 2 common lumber. Assuming that 2 cords equals 1,000 board feet (Chapman and Demeritt, 1936), the figure of 16.5 per cent was doubled to give a quality index for pulpwood trees of 33. Cull trees, which contribute to basal area but not to volume, were given a quality index of 0.

The specifications of the Revised Interim tree grades are as follows:[1]

Grade A —Diameter at breast height 19 inches or more and 5K[2] is less than the d.b.h.

Grade B_1—Diameter at breast height 6 inches to 19 inches, limits of K as above.

Grade B—Diameter at breast height 6 inches or more and 2K is less than the d.b.h.

Grade C—Diameter at breast height 6 inches or more and 2K exceeds the d.b.h.[3]

Pulpwood Grade—Will not make lumber due to excessive sweep, crook, bad knots, or rot, but will yield pulpwood.

Cull Trees—Have no merchantable volume.

Trees representative of Grades A, B_1, B, and C are illustrated in Fig. 2.

Tree grades for hardwoods were based upon the hardwood log grades for standard lumber (U.S. Forest Products Laboratory, 1953). The specifications for these grades are shown at the top of page 9.

Grading of the trees was done on the basis of the butt log, the following grades being recognized:

Tree Grade 1 : Butt log No. 1
Tree Grade 2 : Butt log No. 2
Tree Grade 3 : Butt log No. 3
Tie & Timber : Not suitable for lumber but will make ties or timbers
Local use : Not suitable for ties and timbers but will yield rough lumber for local use

---

[1] Based upon the first 16-foot log. All four faces of the log are inspected.

[2] K is the total number of overgrown knots on the butt log plus the sum of diameters of sound knots plus twice the sum of diameters of unsound knots. A sound knot is any visible branch, stub, or socket which contains neither advanced decay nor any hole larger than ¼ inch. An unsound knot is any visible branch, stub, or socket not conforming to the definition of a sound knot.

[3] Any tree is degraded one grade if d.b.h. equals or is less than 3 times any sweep of 3 inches or more.

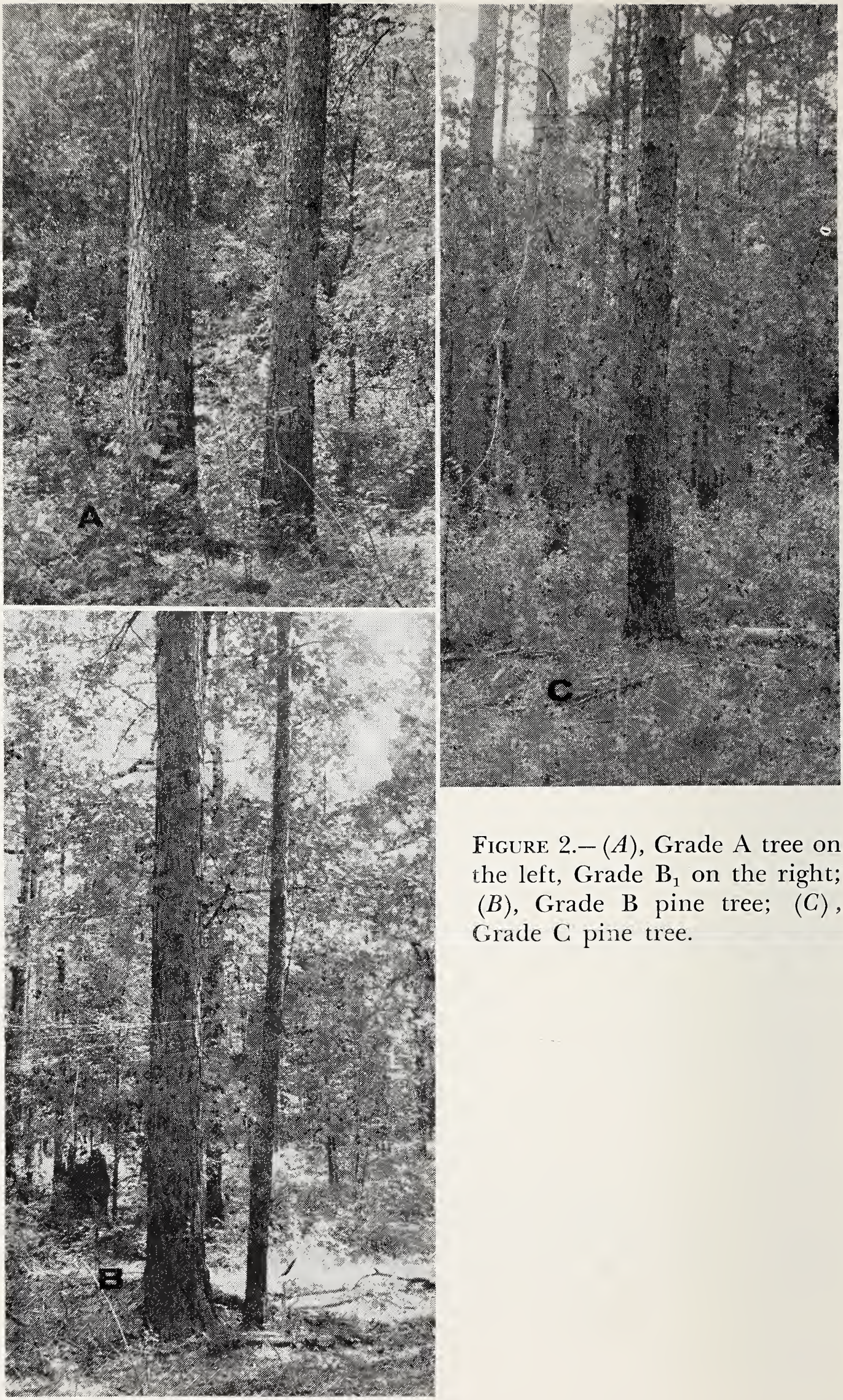


Figure 2.—(*A*), Grade A tree on the left, Grade B_1 on the right; (*B*), Grade B pine tree; (*C*), Grade C pine tree.

Hardwood Log Grades for Standard Lumber

	Butt Logs Only					
Grade Factors	Grade 1			Grade 2		Grade 3
Diameter (minimum)	13"-15"	16"-17"	20"	11"	11"	8"
Length (minimum)	10'	10'	10'	8'	12'	8'
Clear Cuttings (3 best faces)						
Length (minimum)	7'	5'	3'	3'	3'	2'
Number on face (maximum)	2	2	2	2	3	unlimited
Yield in face length (minimum)	5/6	5/6	5/6	4/6	4/6	3/6
Sweep & Crook Deduction (maximum)	15%	15%	15%	30%	30%	50%
Cull Deduction, Inc. Sweep (maximum)	40%	40%	40%	50%	50%	50%

In this grading system, the value of the Number 1 log is used as the base index of 100. Logs which grade No. 2 and No. 3 have an index which is proportionately less than 100. A separate set of indices has been published for each species. However, there is little or no separation by species on the market in the study area, so it seemed feasible to simply average the indices for the species which were encountered. This was done, and the resultant quality indices used for hardwoods in this study are as follows:

Tree Grade	Quality Index
1	100
2	73
3 and Tie & Timber	55
Local Use	35
Cull	0

Crown Position: Only two crown positions were recognized in this study: the upper crown layer, composed of dominant and codominant trees and hereinafter referred to as "dominant"; and the lower layer of the main canopy, composed of intermediate and suppressed trees and hereinafter referred to as "sub-dominant."

COLLECTION AND COMPUTATION OF DATA

All data were tallied in the field on IBM mark-sense cards, one card being required for each tree. The plot number, species, diameter at breast height, merchantable length, tree quality index, crown position, age, and total height were marked directly on the card in code with an electrographic pencil.

All computations of basic data were made directly from the mark-sense cards on the IBM machines. The various formulae necessary to obtain basal area, volume, plot quality index, and plot value were supplied to the IBM Research Programmer, who wired them into the machines and ran the computations.

Basal Area Computations

After computation of the basal area of each tree, cards were sorted by plots, by species group (pine or hardwood), and by crown position. Basal areas of individual trees were then summed and tabulated to give the total basal area on the plot, the basal area in dominant hardwoods, and the basal area in sub-dominant hardwoods. These figures were punched into plot summary cards and converted to percentages by the machine.

Volume Computations

In order to simplify calculations of volume by the IBM machines, a volume formula was worked out for each merchantable height class. These formulae were wired into the machines and the cards sorted by species group (pine and hardwood) and by merchantable height class within the species group. The cards were run through the computer, one set at a time, and the volumes were calculated, punched into the tree cards, and tabulated. They were then sorted again by plot number and species group and summed on the plot cards.

Quality Indices

The individual weighted tree quality indices were obtained by multiplying the tree volume by the quality index for the grade of the tree. Thus a 16-inch, 3-log pine tree of grade B had a weighted index given by $V \times QI = 242 \times 128 = 30{,}976$. These weighted indices were summed by species group within the plot and divided by the total volume of the species group on the plot to give a plot quality index for each species group. This plot quality index for pine was a major dependent variable in this study. Plot quality index for hardwoods was used to obtain plot value, which was the other dependent variable.

Plot Value

Plot value figures used in the analysis are gross values which were based upon the appropriate market values extant at the time of the study. The base market price for pine, equivalent to index 100, was $82.00 per M. board feet (Brannon, 1956). Plot value was obtained from this by multiplying the base value by pine quality index for each grade, multiplying this figure by the volume in the grade, and adding the figures for all grades to get a plot value.

Since the hardwood quality indices are on a different basis, another approach had to be employed to arrive at a base market price for hardwoods. In the hardwood grading system used, the value of the tree of highest grade represents the index base of 100. The values of lower grades are indicated by index figures of less than 100. The price of the highest grade tree is made up by contributions from a number of different grades of lumber which it yields. The average grade-yield of the No. 1 hardwood tree was obtained by averaging the grade-yields for the species encountered. The figures used for grade-yields are those contained in the Forest Products Laboratory report on Hardwood Log Grades (U.S. Forest Products Laboratory, 1953). The resultant composite No. 1 tree has a grade-yield of 29.3 per cent FAS, 34.7 per cent No. 1C, 16.8 per cent No. 2C, and 18.8 per cent No. 3A + B. (These are the standard hardwood lumber grades as defined by the National Hardwood Lumber Association, 1956.)

When these percentages are applied to the average price for each grade (Brannon, 1956), the No. 1 composite hardwood has a gross market value of $91.95 per m.b.f. The computation is 0.293 (137.00) + 0.347 (104.00) + 0.168 (60.00) + 0.188 (30.00). A No. 2 composite hardwood has a gross market value equal to 73 per cent of the value of the No. 1 tree, or $67.12 per M. Likewise a No. 3 tree has a value of $50.12 per M., and a local-use tree has a value of $31.89 per M. Plot value is obtained by multiplying the volume in No. 1 trees by the value per M., the volume in No. 2 trees by the value per M., etc. and summing these figures for the plot. The following tabulation is an example of the calculation of plot value.

Species	Tree Grade	Volume, Board Feet	Value, Dollars per M.	Total Value, Dollars
Pine	A	570	119.72	68.24
	B_1	783	104.96	82.18
	B	400	98.40	39.36
	C	588	82.82	48.70
Hardwood	1	...	91.95	....
	2	...	67.12	....
	3	601	50.57	30.39
	4	184	32.18	5.92
Total Plot Value				274.79

ANALYSIS OF DATA

The basic data were originally subjected to intensive graphic treatment in order to determine whether any relationships between the indepedent variables and quality index of pine could be detected in this manner. So many plotted points were involved and the scatter of these points was so great that it was impossible to ascertain any of these relationships with accuracy. Application of the ordinary techniques for transforming curvilinear relationships to linear relationships resulted in no apparent improvement of the linear graphic relationships of the independent variables to pine quality index. Multiple linear regression was indicated as the method of analysis which would best show the effect of the several independent variables on quality. Accordingly, the basic data were subjected to this statistical treatment, normal equations being solved and Gaussian multipliers obtained by the method of matrix inversion described by Ostle (1954).

The first step in the analysis was to determine whether there were differences in quality index of the pine which were associated with variation in the independent variables. If no such associations were found, further analysis would be of little value. When, however, it was learned that several of the independent variables had a significant effect on quality of the pine timber, it seemed desirable to carry the analysis further and ascertain possible effects on plot value. Pine quality index and plot value, the two dependent variables, are therefore treated separately in the analysis, with pine quality index being assigned priority in the presentation. It should be borne in mind throughout the reading of this report that pine index is an average index of the value, per M. board feet, of the pine lumber in a stand. Plot value, on the other hand, is a measure of the gross stand value, in dollars, per unit of area.

Relationship of Certain Stand Characteristics to Pine Quality Index

To facilitate the presentation and discussion of the data, the dependent and independent variables have been indicated by the following symbols:

Y_1 : Average stand quality index of pine.
Y_2 : Gross plot value in dollars.
X_1 : Total basal area per acre in square feet.
X_2 : Percentage of total basal area in dominant hardwoods, expressed as a whole number.
X_3 : Percentage of total basal area in sub-dominant hardwoods, expressed as a whole number.
X_4 : Average age of stand in years.
X_5 : Site index for pine in feet.

As the first step in analysis an attempt was made to fit an equation of the form: $Y_1 = A + b_1(X_1) + b_2(X_2) + b_3(X_3) + b_4(X_4) + b_5(X_5)$.

The solution of this equation indicated that approximately 26 per cent of the variation in quality index of the pine on the 194 plots studied was associated with variations in the five independent variables included in the regression equation. However, it was suspected that some of the independent variables did not contribute significantly to the regression. Consequently, further regression analysis omitting some of the independent variables from successive regression equations in order to determine their effects upon the regression was indicated. To avoid the necessity of dropping one independent variable at a time in a trial and error method, the partial regression coefficients of the first regression were subjected to a t-test in the manner described by Ostle (1954). This test indicates which of the partial regression coefficients differ significantly from zero.

According to this test, X_2 (percentage of total basal area in dominant hardwoods), X_5 (site index), and X_1 (total basal area) did not contribute significantly to the regression. However, the partial correlation coefficient of Y on $X_{1 \bullet 2,3,4,5}$ did approach significance, so it was deemed advisable to use X_1 along with X_3 and X_4 in a second regression equation.

TABLE 1.—Analysis of Variance and Correlation of Certain Stand Characteristics with Average Stand Quality Index of Pine

Equation No.		Source of Variation	Degrees of Freedom	Sum Squares	Mean Squares	F
		Total Y	193	21,525.300		
(1)	.2559	Regression on $X_{1,2,3,4,5}$	5	5,509.239	1101.848	12.934**
		Residual Y	188	16,016.061	85.192	
(2)	.2476	Regression on $X_{1,3,4}$	3	5,329.167	1776.389	20.839**
		Residual Y	190	16,196.133	85.243	1.056
		Difference, (1)-(2)	2	180.072	90.036	
(3)	.2350	Regression on $X_{3,4}$	2	5,058.674	2529.337	29.338**
		Residual Y	191	16,466.626	86.213	
		Difference, (2)-(3)	1	270.493	270.493	3.137*
		Difference, (1)-(3)	3	450.565	150.188	1.742
(4)	.1755	Regression on X_4	1	3,776.984	3776.984	40.859**
		Residual Y	192	17,748.316	92.439	
		Difference, (3)-(4)	1	1,281.690	1281.690	13.865**

*Approaches significance at the 5 per cent level of probability.
**Significant at the 1 per cent level of probability.

Subsequently, a third regression of Y on X_3 and X_4 was calculated. The squared correlation coefficients and the analysis of variance for each of the resulting regression equations are presented in Table 1.

The analysis presented in Table I indicates that the regression of average stand quality index of pine on the five stand characteristics considered is primarily dependent upon the contributions of (1) percentage of total basal area in sub-dominant hardwoods and (2) age of the stand.

Twenty-six per cent of the variation of stand quality index of pine on the plots studied is associated with variations of the five independent variables. The deletion of percentage of basal area in dominant hardwoods and site index from the regression results in an insignificant reduction in the degree of association of the dependent with the independent variables.

The third regression equation omits total basal area as an independent variable. The regression is still significant at the 1 per cent level and has a squared correlation coefficient of 0.235, indicating that 23.5 per cent of the variation in the dependent variable is associated with variations in percentage of basal area in sub-dominant hardwoods and age of stand. The difference between this regression and regression (2), which contained total basal area as an independent variable, approaches significance at the 5 per cent level, indicating that current total basal area has some influence on pine quality index.

The difference between the regression on X_3 (percentage of total basal area in sub-dominant hardwoods) and X_4 (average age of stand) (3) and the regression on X_4 alone (4) is highly significant, and there is a reduction in the squared correlation coefficient of 0.0595, indicating that approximately 6 per cent of the variation in the dependent variable is accounted for by the variations in X_3. Therefore, it can be concluded that both X_3 and X_4 are important components of the third regression equation.

An attempt to gain further information about the relationships of the dependent and independent variables was made by testing the significance of the fourth-order partial correlation coefficients (Ostle, 1954). These coefficients measure the degree of linear association between the dependent variable and any one independent variable after taking into account its association with the other four independent variables. The coefficients are presented in Table 2.

TABLE 2.—Fourth Order Partial Correlation Coefficients

Correlation Coefficient Symbol	Regression of Quality Index On:	r^2	r
$Y_{5 \bullet 1,2,3,4}$	Site index	.0003	.0173
$Y_{2 \bullet 1,3,4,5}$	Dominant hardwoods	.0139	.1179
$Y_{1 \bullet 2,3,4,5}$	Total basal area	.0201	.1418*
$Y_{3 \bullet 1,2,4,5}$	Sub-dominant hardwoods	.0712	.2682**
$Y_{4 \bullet 1,2,3,5}$	Age of stand	.0849	.2914**

*Approaches significance.
**Significant at the 1 per cent level of probability.

These coefficients indicate the degree of linear association between the dependent variable and one of the independent variables when the association of the dependent with all other independents is taken into account. In this study there is a lack of linear association between pine quality and either site index or percentage of dominant hardwoods, all other variables taken into account.

The relationship between present stand density and pine quality index approaches significance. While it is not possible to infer the early stand density from the present stand density, it seems likely that early stand density has an influence on the quality of the pine lumber.

Highly significant linear relationships between pine quality index and percentage of basal area in sub-dominant hardwoods and pine quality index and age of stand, other independent variables considered, are indicated. Inasmuch as the partial regression coefficients (Table 3) for these two independent variables are positive, an increase in percentage of basal area in sub-dominant hardwoods, or an increase in age, or an increase in both of these factors, will result in a raising of the quality of the pine lumber produced, all other independent variables studied being held constant.

Since only X_3 and X_4 of the independent variables in this study have been shown to have significant effects on the quality of pine produced, the final regression equation is based upon them:

Pine Stand Quality Index = 96.576 + 0.31014216 (percentage of basal area in sub-dominant hardwoods) + 0.37786008 (age of stand)

The standard error of the estimate for this regression equation is 9.285 points of quality index, which is 8 per cent of the mean quality index.

TABLE 3.—Partial Regression Coefficients—Regression of Pine Quality Index on All Independent Variables

b_1	+0.04410411
b_2	+0.05363978
b_3	+0.30545570
b_4	+0.39584647
b_5	+0.02028121

The data presented in Table 1 also indicate that a prediction of quality index might be made using age as the only independent variable. Average age of the stand is much more easily obtained than is percentage of basal area made up by sub-dominant hardwoods, and it is conceivable that estimates of pine quality index based on age alone might be of value. Therefore the equation for pine quality index based on age of stand alone has been derived:

Pine stand quality index = 99.442 + 0.37919624 (age of stand)

The standard error of the estimate of this regression is 9.614 quality index points, indicating that stand quality index of pine can be predicted within 9.6 points on the basis of age of stand alone about two-thirds of the time. It should be emphasized that this regression and the previous regression are valid only within the range of ages and mixtures with sub-dominant hardwoods which were found on the experimental plots.

Relationship of Certain Stand Characteristics to Gross Plot Value

It has been shown that two of the stand characteristics studied, age of stand and percentage of total basal area made up of sub-dominant hardwoods, play important roles in developing quality in pine lumber. Increases in value of the pine with increments in age of stand and percentage of total basal area in sub-dominant hardwoods are implied. If pure pine stands were considered, any increase in value of the pine would be reflected in an increase in per-acre or per-plot value. When mixed stands are in question, the final plot value is the result of a combination of factors. Generally the hardwoods which are associated with loblolly pine are lower in value than the pine. Even if hardwoods and pines of the same diameter had the same volume, the pine would be worth more, and any increase in percentage of the stand composed of pine would result in an increase in plot or per-acre value.

The hardwoods associated with loblolly pine generally do not attain the merchantable volume produced by pines of the same diameter. Taper is more pronounced, resulting in lower form class and lower volume, and hardwoods seldom attain a merchantable height equal to that of pine.

It seemed desirable, therefore, to ascertain the effects of the independent variables included in this study on the gross value of the timber produced on each plot.

The first step in analysis was to attempt to fit an equation of the form: $Y_2 = A + b_1(X_1) + b_2(X_2) + b_3(X_3) + b_4(X_4) + b_5(X_5)$. The solution of this equation indicated that approximately 86 per cent of the variation in gross value of the 194 plots studied was associated with variations of the five independent variables. Further regression analysis, omitting some of the independent variables from successive regression equations, was employed to determine the effects of the various independent variables. The squared correlation coefficients and analysis of variance for each of the resulting regression equations are presented in Table 4.

This analysis indicates that site index (X_5) is the only independent variable which does not contribute significantly to gross plot value. The regression on the other four independent variables accounts for 85.87 per cent of the variation in the dependent variable.

TABLE 4.—Analysis of Variance and Correlation of Certain Stand Characteristics with Gross Plot Value

Equation No.	R^2	Source of Variation	Degrees of Freedom	Sum Squares	Mean Square	F.
		Total	193	2,674,792.758		
(1)	.8602	Regression on $X_{1,2,3,4,5}$	5	2,300,951.891	460,190.218	231.424**
		Residual Y	188	373,840.867	1,988.515	
(2)	.8587	Regression on $X_{1,2,3,4}$	4	2,296,773.085	574,193.271	287.082**
		Residual Y	189	378,019.673	2,000.104	
		Difference, (1)-(2)	1	4,178.806	4,178.806	2.089
(3)	.3983	Regression on $X_{2,3,4}$	3	1,065,426.812	355,142.270	41.929**
		Residual Y	190	1,609,365.946	8,470.347	
		Difference, (2)-(3)	1	1,231,346.273	1,231,346.273	145.731**
(4)	.3654	Regression on $X_{2,3}$	2	977,315.989	488,738.385	54.992**
		Residual Y	191	1,697,476.769	8,887.313	
		Difference, (3)-(4)	1	88,110.866	88,110.866	9.914**
(5)	.3478	Regression on X_2	1	930,393.281	930,393.281	102.405**
		Residual Y	192	1,744,399.477	9,085.414	
		Difference, (4)-(5)	1	46,922.512	46,922.512	5.165*
(6)	.8044	Regression on $X_{1,2}$	2	2,151,673.753	1,075,836.876	392.807**
		Residual Y	191	523,119.005	2,738.843	
		Difference, (1)-(6)	3	149,278.138	49,759.379	18.168**

*Significant at the 5 per cent level of probability.
**Significant at the 1 per cent level of probability.

While the differences between regressions (3) and (4), and (4) and (5) are significant at the 1 per cent level of probability and the 5 per cent level of probability respectively, the reductions in R^2 brought about by deleting X_4 (age of stand) and X_3 (percentage of total basal area in sub-dominant hardwoods) are relatively small compared to the R^2 obtained with the regression on $X_{1,2,3,4}$. Variations in gross plot value, therefore, are largely associated with variations in total basal area and percentage of total basal area which is in dominant hardwoods. This is substantiated by the R^2 of the regression on $X_{1,2}$, which shows that 80 per cent of the variation in the gross plot value is associated with variation in these two independent variables.

The effects of total basal area, percentage of basal area in dominant hardwoods, and age of the stand on the gross plot value are easily understood. Gross plot value is largely influenced by volume, and total basal area has a strong influence on volume. It would be expected, therefore, that there would be a strong positive correlation between gross plot value and total basal area. Such is the case, as is shown by the partial correlation coefficent for the regression of Y_2 on X_1, (Table 5), all other independent variables taken into account.

The strong negative partial regression coefficient (Table 6) for percentage of basal area in dominant hardwoods is to be expected. Less volume is produced per square foot of basal area by hardwoods than by pines, so per-acre volumes are materially reduced when the percentage of the stand in hardwoods rises sharply. Also, the value per unit of volume is less for the hardwoods. The interaction of these two factors will cause a reduction in plot or per-acre value, all other independent variables held constant.

Age of stand makes important contributions to plot or per-acre value in two ways. The previous analysis has demonstrated the positive correlation between age and quality index of the pine component. This independent variable also contributes to stand value because of the simple fact that the older stands, at least up to the point where mortality exceeds increment, have a greater volume per unit of area. The combination of greater volume and a higher percentage of the better grades of lumber results in higher per-acre values.

Additional insight into the relations between the stand characteristics studied and gross plot value may be gained from an inspection of the partial correlation coefficients embodied in Table 5.

These coefficients give an indication of the degree of linear association between the dependent variable (gross plot value) and one independent variable, with all other independent variables which were studied being held constant. As is indicated in the table, no correlation between gross plot value and site index, the other independents being held constant, was found. There appear to be strong correlations between gross plot value and each of the remaining independent variables when all others are held constant. Thus, if we do not vary the percentage of basal

TABLE 5.—Fourth Order Partial Correlation Coefficients

Correlation Coefficient Symbol	Regression of Gross Plot Value On:	r^2	r
$Y_{5 \bullet 1,2,3,4}$	Site index	.0092	.096
$Y_{2 \bullet 1,3,4,5}$	Dominant hardwoods	.4838	.696**
$Y_{1 \bullet 2,3,4,5}$	Total basal area	.7641	.874**
$Y_{3 \bullet 1,2,4,5}$	Sub-dominant hardwoods	.1553	.394**
$Y_{4 \bullet 1,2,3,5}$	Age of stands	.1273	.357**

**Significant at the 1 per cent level of probability.

area in dominant hardwoods, the percentage of basal area in sub-dominant hardwoods, the stand age, or site index, gross plot value will be strongly correlated with basal area, and any changes in basal area will be reflected by changes in gross plot value. Inasmuch as the partial regression coefficient for total basal area is positive, the gross plot value will increase with increases in total basal area and vice versa.

Gross plot value is also strongly correlated with percentage of total basal area which is composed of dominant hardwoods, all other independent variables studied being held constant. In this instance, however, the partial regression coefficient is negative, indicating a lowering of gross plot value when dominant hardwoods make up a larger percentage of the total basal area.

The partial correlation coefficient between gross plot value and percentage of basal area in sub-dominant hardwoods, all other independent variables being held constant, is significant at the 1 per cent level, indicating a definite influence of sub-dominant hardwoods on gross plot value. The partial regression coefficient is negative; therefore, as the percentage of basal area in sub-dominant hardwoods rises, gross plot value will be lowered. This would appear to be inconsistent with the positive effect of sub-dominant hardwoods on pine quality index which has been shown in the previous analysis. If all other factors were equal, any increase in quality index of the pine should be reflected in increases in the gross plot value. However, the hardwoods which are associated with pine on the study plots do not produce as much lumber for a given size of tree as do the pines. They are characterized by a sharper taper and shorter merchantable height, both of which result in lessened volume.

TABLE 6.—Partial Regression Coefficients—Regression of Gross Plot Value on All Independent Variables

b_1	+2.69464912
b_2	—2.10228929
b_3	—2.27406947
b_4	+1.16099051
b_5	+0.72706084

The implication of this apparent inconsistency is that the increased value resulting from higher quality index is offset by a lowered total volume. This suggests that the relationship between gross plot value and percentage of basal area in sub-dominant hardwoods may be curvilinear. In other words, gross plot value increases with increases in the amount of sub-dominant hardwoods up to a certain point, and decreases thereafter.

Possible curvilinearity of this relationship was checked by adding a new variable, $X_6 = (X_3)^2$, and computing a new regression of Y_2 on X_1, X_2, X_3, X_4, and X_6. The addition of the new variable was accomplished by use of the Gaussian multipliers in the method described by Cochran (1938).

The fact that a limited amount of sub-dominant hardwoods has a beneficial effect on gross plot value is indicated by the fact that the new partial regression coefficient, 0.55429438, for X_3 (percentage of basal area in sub-dominant hardwoods) is significant and positive, while the partial regression coefficient for X_6, -0.01636995, is significant and negative.[1]

Assuming that a limited amount of sub-dominant hardwoods has a beneficial effect on gross plot value, it then remains to ascertain the optimum amount of sub-dominant hardwoods. This was accomplished by differentiating with respect to X_3 and equating to zero as follows:

$$b_3 + 2b_6X_3 = 0$$

$$\text{Optimum } X_3 = \frac{-b_3}{2b_6} = 5.63 \text{ per cent}$$

The correlation of gross plot value with age of stand, all other independent variables being held constant, is highly significant. The reduction in the squared correlation coefficient when age of stand is deleted is 0.0329, indicating that approximately 3 per cent of the variation in gross plot value is associated with variations in age of the stand. Positive changes in age, with the other independent variables being held constant, will result in higher gross plot values.

DISCUSSION OF RESULTS

Pine Quality Index

The basic concept of quality in this study is freedom from knots. Freedom from knots implies that the branches, through some physical or biological action, are removed from the main stem of the tree so that the secondary or diametral growth results in annual increments of clear wood substance. The factors, either physical or biological, which bring about this natural pruning are not well understood, and it is probable that the natural shedding of branches is a result of the interaction of many such factors.

---

[1] The author is indebted to Dr. George M. Furnival of the Yale School of Forestry for suggesting this technique.

It has been shown that a small proportion of sub-dominant hardwoods in loblolly pine stands has a beneficial effect on the quality of the lumber, hence on natural pruning. Why should this be so? Undoubtedly one of the reasons is found in the modification of the microclimate beneath the canopy. The amount of sunlight available to the lower limbs in a stand which contains a considerable number of hardwoods in the understory is probably much less than that available in a similar stand with no understory hardwoods. In the case of species which are relatively intolerant of shade, this would have the effect of causing death of the side branches at an earlier age and smaller diameter than would be the case with more tolerant species or in stands where more sunlight is available. The diameter attained by the side branches before they die will be of considerable importance in determining the time elapsed before they fall off and are occluded. Under similar conditions of microclimate, fungal attack, weathering, and mechanical action, the smaller branch will fall off and the stub will be overgrown more quickly than in the case of the larger branch.

It may be that there are genetic differences in loblolly pine which will result in earlier death, and death at smaller diameters, of the branches. Until more substantial evidence is uncovered, however, the matter of available light must be considered of prime importance. Available light within any given area will depend upon the density of the crown cover, and any stand conditions which tend to increase the density of crown and reduce the amount of available light should result in death of the side branches at a smaller diameter. The presence of subdominant hardwoods in the stand will result in an increase in density of crown cover and a consequent decrease in available light. Because of the fact that this decrease in available light will occur during the growing season, it may be equally as important as heavy crown cover at all times.

Another factor which undoubtedly alters the amount of available light and has, therefore, an influence on the death of the side branches is density of stocking, particularly during the early years of the stand. In this investigation it has not been shown that there is any strong correlation between the present stand density and the quality of the butt log. There is some indication, however, that stand density affects quality; therefore, it cannot be concluded that early stand density does not play an important role. Until further research indicates otherwise, it must be assumed that heavy stand density during the early years of the life of the stand will result in early death of the side branches.

Once the side branches have died, the date of beginning of production of clear wood will be dependent upon the detachment of the branches and occlusion of the branch stubs. The length of time that the dead branches persist is probably dependent upon the interaction of a number of factors. Ultimately the branch is broken off, either entirely at one time or a small piece at a time until the branch is entirely gone. This break-off may be occasioned by mechanical action of the neighboring trees and branches, by the weight of precipitation, by animals, or by the weight of the branch itself. Any factor which tends to weaken the branch mechanically will make it much more susceptible to such mechanical action. Attacks by saprophytic fungi and insects are probably the most important weakening factors. The intensity of fungal attack on wood is conditioned largely by the moisture content of the wood and the temperature (Hunt and Garratt, 1953). Any alterations of the microclimate which tend to make these factors more nearly optimum for the growth of fungi would hasten and intensify fungal attack and result in earlier weakening and earlier break-off of the branches. Stands which contain a heavy understory will ordinarily have a microclimate which is characterized by a higher relative humidity and lower wind velocities than that found in stands without such an understory. These conditions result in a higher moisture content in the dead wood of the branches and a consequent more favorable environment for fungi.

Rate of growth in diameter, once the dead limbs have fallen or been broken off, determines the length of time required to occlude the branch stubs or knots and the rate of production of clear lumber. It is important, therefore, that pine stands be so managed that a high rate of diametral growth is maintained, when the production of clear lumber is the main objective.

No significant relationship was established between pine quality and the percentage of the basal area in dominant hardwoods. It may well be asked why these hardwoods which are a part of the main crown canopy do not have any influence on quality while trees of the same species with their crown in the lower portion of the main canopy have definite beneficial effects. The answer probably lies in the position of the crowns of these trees relative to the crowns of the pines with which they are associated. Generally they are as tall as the pines, in some cases taller. Any modifications of microclimate resulting from reduction of wind velocities and rates of evaporation beneath the canopy would thus be lost. Also, in stands where there are dominant hardwoods but few or no sub-dominant hardwoods, some light from the side (coming through occasional openings in the canopy) falls on side branches of the pines and enables them to live for a longer period of time. Furthermore, any dominant hardwoods in pine stands are probably causing a reduction in the rate of diametral growth of the pine and thereby possibly offsetting any benefits to pruning which result from shading by lengthening the period of time required for occlusion of knots and branch stubs.

Under the very best of conditions, loblolly pine does not prune itself as rapidly as is desirable, and even though the lower limbs may die when still relatively small, they frequently persist for years after death. Since this is true, it would seem desirable to employ more intensive management practices and prune 70 to 100 crop trees per acre artificially. The financial aspects of such an operation are beyond the scope of this report, but the objective should be to produce a clear stem 16 to 32 feet long which has a knotty core with a diameter of five inches or less. When the pruning job is left to nature, this objective is attained very infrequently and then only by trees which are long suppressed.

Once a clear bole is obtained, the amount of clear lumber which is produced and the quality index of the tree will be dependent upon how long the tree is allowed to stand and grow. The analysis has shown that the age of the stand has a strong effect on the quality of lumber which is produced. It should be advantageous, therefore, when the production of lumber which will grade C or better is desired, to extend the rotation period of loblolly pine to 80 to 100 years. Rotations of 60 years or less will not result in the production of a high percentage of high quality sawlogs.

When the other independent variables are taken into account, there is no significant relationship between site index and pine quality index. However, when only site index and pine quality index are considered, there is a significant and negative relationship. It might be assumed, on first thought, that a good site index would result in the production of high quality lumber. When the nature of site index calculations is taken into account, however, it becomes apparent that this is not necessarily the case. Site index is a measure of the growth capacity of the land as reflected in the height of the dominant trees at 50 years of age. The average quality indices for the various tree grades are related to height only insofar as the total volume within a grade is affected by the merchantable height of the trees. The contributions of grade-yield to the average quality indices are greater than the volume contributions made by increases in height; therefore, any beneficial effects on quality index brought about by site index are rather small. On the other hand, it is reasonable to assume that anything about the site which results in greater height growth over a period of years will also be reflected in generally better vigor of the trees which make up the stand. It is logical to assume that all parts of the trees share in this healthy condition; therefore the side branches should be more slowly affected by the conditions which cause their death.

Stand composition has long been thought to have considerable influence upon the quality of lumber produced, and it has been rather generally conceded that mixtures produce higher quality lumber than pure stands. The data considered herein lead to conclusions which substantiate this view in part.

Gross Plot Value

This investigation also revealed certain significant relationships between the gross dollar value of the plots and some of the stand conditions which were studied. In general, gross dollar value per unit of forest area is associated with the volume and price for the various species which make up the volume. The hardwoods which are associated with loblolly pine ordinarily produce less merchantable volume per square foot of basal area than do the pines. As a result, when the production of hardwoods is higher, the volume per unit of area is lowered. Therefore, even if both the pine and the hardwood had the same value per unit of volume, the gross value per acre would be less in mixed stands than in pure pine stands. In the area under consideration the hardwoods are much lower in value per unit of volume than is the pine. Therefore, given equal total volumes per acre, the acre with all pine or with the most pine would have the greater gross value unless the lowered volumes were offset by much higher pine quality brought about by the associated hardwoods. This does not occur.

When the factors of lower volume per unit of area and lower value per unit of volume are put together, it becomes obvious that hardwoods in the pine stands will result in reduced gross values per unit of area. The significant, negative relationship between dominant hardwoods and gross plot volume shown by the study data substantiates this thesis. Dominant hardwoods have no place in the management, for timber, of loblolly pine stands in the area under consideration.

A seeming paradox exists in the fact that the sub-dominant hardwoods have a considerable beneficial effect on the quality of the pine lumber which is produced and, on the other hand, have a significant and negative effect on gross plot value. The strong positive relationship between pine quality index and percentage of basal area in sub-dominant hardwoods leads one to the conclusion that these hardwoods should be retained in the stand, although when the relationship between them and the gross plot value is considered, the opposite conclusion is indicated. Consideration of the effect of hardwoods in the stand on the total volume per unit of area leads to a solution of this seeming inconsistency. It is apparent that the higher quality and value per board foot of the pine which results from the presence of the sub-dominant hardwoods is offest at some point by the reduced per-acre volume which they bring about. Determination of this point is important to the forest manager who is interested in the greatest gross return. The statistical analysis has indicated that gross plot value increases with increasing percentages of sub-dominant hardwoods up to 5.63 per cent and from that point on, decreases.

Ideal Stand Conditions

Because of the number of variables which are involved in the production of a stand of timber of high quality and high value, it is not possible to define, precisely, any ideal stand conditions. It may be of interest, however, to see the conditions which resulted in high quality and high value in this study. An average plot was constructed by selecting five plots which had high gross plot values and also high pine quality indices, and averaging the values of the various variables. Following are the data for this average "best" plot.

Site index in feet	86
Age of stand in years	50
Stand quality index of pine	129.70
Gross value per acre in dollars	2,644.41
Basal area per acre in square feet	
Dominant pine	120.97
Sub-dominant pine	9.90
Dominant hardwood	17.50
Sub-dominant hardwood	16.96
Total basal area	165.33
Percentage of total basal area in:	
Dominant pine	73.17
Sub-dominant pine	5.99
Dominant hardwood	10.58
Sub-dominant hardwood	10.26
Number of trees per acre	
Dominant pine	65
Sub-dominant pine	13
Dominant hardwood	7
Sub-dominant hardwood	30
Total number of trees per acre	115
Average diameter, all pines, inches	16.30
Average diameter, all hardwoods, inches	12.90

SUMMARY AND CONCLUSIONS

Present management practices in the loblolly pine region are largely directed toward the growth of pure pine stands. The philosophy underlying such practices, production of the greatest volume of the most valuable species, is sound. At the same time there is widespread concern over the generally low quality of second-growth southern pine, loblolly included. There has been much speculation about the effects of hardwood mixtures on pine quality; however, little research has been aimed at this specific question. Consequently, a project designed to ascertain the effects of certain stand characteristics on the quality of pine lumber produced was initiated.

A review of the literature brought out certain generalizations:

1. Hardwood encroachment in the loblolly pine region is the basis for management practices designed to hold the hardwood component of forest stands to a minimum.

2. Efforts to reduce the hardwood component have resulted in the development of tools and methods which give promise of relegating the hardwoods to a position of minor importance in the stand.

3. Little thought has been given, by foresters as a group, to the effect of hardwood subjugation on the quality of pine lumber.

4. On the average, second-growth southern pine produces lumber which is lower in quality than is desirable and attainable.

5. The greatest values from growing trees may be obtained with a shift of emphasis from quantity production to quality production. Manipulations of quality are within the scope of the forest manager.

6. Relations between growth conditions and the quality of lumber produced are not well known. Investigations in regions other than the South have indicated that quality of a particular species, as determined by size and frequency of knots, is affected by density of stocking and the presence of another species in the stand.

7. The only investigation which dealt specifically with loblolly pine revealed that the greatest fluctuations in value of pine lumber were associated with stand composition (with respect to age and amount of hardwoods in mixture with the pines) and the rate of stocking in pure or nearly pure pine stands.

The field work for this study was conducted during the summer of 1955 in the Florida Parishes of southeastern Louisiana. A total of 194 sample plots were randomly located in loblolly pine-hardwood stands of sawtimber size. Data were collected which permitted the calculation of the following plot characteristics: (1) pine quality index, (2) gross plot value, (3) total basal area, (4) percentage of basal area in dominant hardwoods, (5) percentage of basal area in sub-dominant hardwoods, (6) age of the stand, and (7) site index for pine.

The data obtained were analyzed statistically with the following results:

1. The relationship between quality index of pine and five stand characteristics—total basal area per acre, percentage of total basal area in dominant hardwoods, percentage of total basal area in sub-dominant hardwoods, age of stand, and site index—was found to be statistically significant. Approximately 26 per cent of the variation in pine quality index was associated with variations in these five factors.

2. Pine quality index was shown to be generally higher in older stands and in stands composed of sub-dominant hardwoods growing with pine. Age of stand appears to be the most important factor in the production of high quality pine lumber.

3. In middle-aged and mature stands of loblolly pine, present stand density, site index, and the presence of dominant hardwoods have little to do with the quality of the butt log.

4. The relationship between gross plot value in dollars and the same five stand characteristics was significant, and approximately 86 per cent of the variation in gross plot value was associated with variation in the stand characteristics studied.

5. Site index had no significant effect on gross plot value. When this factor was excluded from the analysis, the remaining four independent variables accounted for nearly as much of the variation in gross plot value.

6. Plot value was generally higher in older stands, in stands with

high total basal area, and in stands with low amounts of dominant hardwoods.

7. The relationship between percentage of the basal area in sub-dominant hardwoods and gross plot value is curvilinear. It appears that the optimum amount of sub-dominant hardwoods is about 5 per cent of the total basal area.

These results may be summed up in three general conclusions.

1. If the objective of management is to grow loblolly pine which has long, clear boles which will produce a high proportion of the finish grades of lumber, management has two principal alternatives: (a) select 70 to 100 crop trees per acre at an early age of the stand and by artificial pruning carried out in 3 or 4 stages produce this number of trees with the first 32 feet of the bole having a knotty core not more than 5 inches in diameter; or (b) employ a long rotation, possibly 80 to 100 years, and maintain 5 per cent of the stand basal area in sub-dominant hardwoods which are well distributed throughout the stand.

2. Dominant hardwoods have no place in the management of loblolly pine within the area under consideration. Mixtures where the crowns of the hardwoods and crowns of the pines occupy the same relative position will not yield the maximum dollar value per unit of area.

3. The chief values of mixtures in enhancing natural pruning in loblolly pine appear to result from the sub-dominant hardwoods in the mixture and not from the dominant hardwoods. It is strongly suspected that this relationship may apply to other coniferous species.

LITERATURE CITED

Brannon, Paul J. 1956. Lumber market report. April 14, 1956. Jackson, Mississippi.

Chapman, H. H., and Dwight B. Demeritt. 1936. Elements of Forest Mensuration. Second ed. 451 pp. J. B. Lyon Company, Albany, N. Y.

Clark, S. F., and H. L. Williston. 1947. Control of low-grade hardwoods in shortleaf-loblolly pine management. U.S.D.A. Forest Service, Southern Forest Experiment Station, Crossett branch. Mimeographed Release.

Cline, A. C., and C. R. Lockard. 1935. Mixed white pine and hardwoods. Harvard Forest Bulletin No. 8. 67 pp. Petersham, Mass.

Demmon, E. L. 1953. Forest research and its relation to the wood using industries in the southeast. Journal Forest Products Research Society III:2:10-12 and 85.

Foster, Clifford H. 1953. The importance of timber quality as a goal in silviculture. Journal of Forestry 51:7: 487-490.

Garren, K. H. 1943. Effect of fire on the vegetation of the southeastern United States. Botanical Review 9:617-654.

Grosenbaugh, L. R., W. R. Smith, T. A. McClay, T. C. Evans, E. J. Schlatter, and W. C. Callender, 1953. Interim log grades for southern pine. U.S.D.A., Forest Service.

Hunt, George M., and George A. Garratt. 1953. Wood preservation xi + 417 pp. McGraw-Hill Book Company, Inc. New York. 1953.

National Hardwood Lumber Association. 1956. Rules for the measurement and inspection of hardwood lumber, cypress, veneers, and thin lumber. 112 pp. Chicago, 1956.

Ostle, Bernard. 1954. Statistics in research. xiv + 487 pp. Iowa State College Press, Ames, Iowa.

Owens, C. B. 1955. Chemical eradication of turkey oak. Down to Earth (published by Dow Chemical Company) 11:4: 23-24.

Paul, Benson H. 1932. The relation of certain forest growth conditions to the quality and value of second growth loblolly pine lumber. Journal of Forestry 30:4-21.

Peevy, Fred A. 1953. Chemical control of southern upland hardwoods. Proceedings, Second Annual Symposium, Louisiana State University School of Forestry.

Rapraeger, E. F. 1939. Development of branches and knots in western white pine. Journal of Forestry 37:239-245.

Reynolds, R. R. 1947. Management of second growth shortleaf-loblolly pine-hardwood stands. Journal of Forestry 45:181-187.

Riebold, R. J. 1955. Prescribed burning in loblolly pine management. Proceedings, Fourth Annual Symposium, Louisiana State University School of Forestry.

Silker, T. H. 1953. Prescribed burning for control of understory hardwoods invading southern pine stands. Proceedings, Second Annual Symposium, Louisiana State University School of Forestry.

Southern Forest Experiment Station. 1955. Forests of Louisiana. Forest Survey Release No. 75, U.S.D.A., Forest Service, Southern Forest Experiment Station.

Tarbox, E. E., and P. M. Reed. 1924. Quality and growth of white pine as influenced by density, site, and associated species. Harvard Forest Bulletin No. 7. 30 pp. Petersham, Mass.

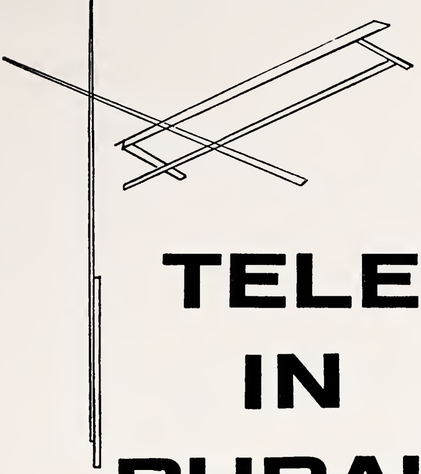
United States Department of Agriculture. 1929. Volume, yield, and stand tables for second-growth southern pine. Miscellaneous Publication 50. U. S. Department of Agriculture.

United States Forest Products Laboratory. 1953. Hardwood log grades for standard lumber. U.S.D.A., Forest Service, Forest Products Laboratory. No. D-1737.

Vincent, Paul Y. 1955. The use of fire in the management of the shortleaf-loblolly-hardwood type on the Texas National Forest. Proceedings, Fourth Annual Symposium, Louisiana State University School of Forestry.

Weaver, John E., and F. E. Clements. 1938. Plant Ecology. xx + 520 pp. McGraw-Hill Book Company, New York.

Bulletin No. 518
December 1958



TELEVISION IN RURAL LOUISIANA

Alvin L. Bertrand and Frederick L. Bates

Agricultural Experiment Station
Charles W. Upp, Director
Louisiana State University and
Agricultural and Mechanical College

TABLE OF CONTENTS

PAGE

I. SUMMARY 4

II. INTRODUCTION 5
  - Objectives of the Study 6
  - Methodology 6
  - Description of Sample Population 7
  - Description of Television Sets in Rural Homes 9

III. TELEVISION VIEWING PATTERNS 9
  - Weekday Viewing Patterns 10
    - Weekday Viewing Habits of Men 10
    - Weekday Viewing Habits of Women 11
  - Saturday Viewing Patterns 13
    - Saturday Viewing Habits of Men 13
    - Saturday Viewing Habits of Women 14
  - SUNDAY VIEWING PATTERNS 15
    - Sunday Viewing Habits of Men 16
    - Sunday Viewing Habits of Women 16
  - DIFFERENCES BETWEEN VIEWING PATTERNS IN NORTH AND SOUTH LOUISIANA .. 17

IV. TELEVISION PROGRAM PREFERENCES 17

V. INTERESTS AND PREFERENCES RELATING TO AGRICULTURAL TELECASTS 18
  - The Agricultural Program Audience 19
  - Television as the Preferred Medium for Farm News and Market Reports .. 19
  - Time Preference for Farm and Home Programs 19

VI. THE IMPACT OF TELEVISION ON SELECTED LEISURE-TIME ACTIVITIES 20
  - Changes in Radio Listening Habits 20
  - Changes in Movie Attendance and Reading Habits 22

VII. NON-OWNERS' USE OF TELEVISION AND THEIR FEELINGS ABOUT IT 23

LIST OF TABLES

I. Distribution of the Sample Populations by Survey Areas 7

II. Age of Interviewees in Television and Non-Television Households 8

III. Educational Attainment of Interviewees in Television and Non-Television Households 8

IV. Television Program Preferences of Interviewees, by Sex 18

V. Interviewees Preferred Source of Farm News and Market Information, by Race and Sex 20

VI. Interviewees Changing Their Radio Listening Habits Because of Television, by Sex and Race 21

VII. Interviewees Changing Their Movie Habits Because of Television, by Sex and Race 22

LIST OF ILLUSTRATIONS

I. Percentages of Rural Men from Television Households Who Reported Viewing Regularly at Specified Times on Weekdays, by Major Cultural Regions, Louisiana, 1956 11

II. Percentages of Rural Women from Television Households Who Reported Viewing Regularly at Specified Times on Weekdays, by Major Cultural Regions, Louisiana, 1956 12

III. Percentages of Rural Men from Television Households Who Reported Viewing Regularly at Specified Times on Saturday, by Major Cultural Regions, Louisiana, 1956 13

IV. Percentages of Rural Women from Television Households Who Reported Viewing Regularly at Specified Times on Saturday, by Major Cultural Regions, Louisiana, 1956 14

V. Percentages of Rural Men from Television Households Who Reported Viewing Regularly at Specified Times on Sunday, by Major Cultural Regions, Louisiana, 1956 15

VI. Percentages of Rural Women from Television Households Who Reported Viewing Regularly at Specified Times on Sunday, by Major Cultural Regions, Louisiana, 1956 16

SUMMARY

Television has, in a matter of less than a decade, become a dominant force on the American scene, rural as well as urban. Its impact on rural life has been such as to alter profoundly the leisure-time patterns of rural men and women and to influence greatly their use of other media of communication. The television use and preference patterns of adult persons in rural areas of the state may be summarized as follows:

1. On weekdays, there is only one peak viewing period for rural men—from 7 to 10 p.m. Between 8 and 9 p.m. as many as 90 percent of the men interviewed from television homes were watching their sets. The peak viewing time for women on weekdays is the same as that for men. Women, however, exceed men in the television audience, relatively, at almost every period of the day.

2. The Saturday viewing habits of men differ somewhat from their weekday patterns in that more of them use their television sets during the pre-evening hours—between 12 noon and 6 p.m. In contrast, fewer women view television on Saturday afternoon than during the week.

3. More men use their TV sets on Sunday afternoon than on weekday or Saturday afternoon, but fewer of them watch on Sunday evening than on weekday or Saturday evening. Women do not show as distinct a pattern in this respect, although there are fewer rural women in the television audience on Sunday evenings than at that time on Saturdays or weekdays.

4. There is at least one major difference in television viewing patterns of rural people in North Louisiana and those in South Louisiana. This difference is in time preferences. North Louisianians use television more before 6 p.m. and South Louisianians more after this hour.

5. Rural men prefer sports telecasts above all other programs, with comedy programs being their second choice for viewing fare. Rural women name "comedy" programs as their first viewing preference and "mystery" programs as their second choice.

6. Although rural adults do not rank informational and educational programs high among their viewing preferences, about three-fifths of them regularly view agricultural programs. The men were especially interested in programs dealing with farm enterprises, while the women favored cooking and food preservation programs.

7. Most rural persons prefer to view agricultural programs between 6 and 8 p.m. Their second time preference is during the noon hour.

8. Television has drastically reduced the time rural people devote to radio, movies, and reading.

9. The majority of rural non-TV owners in the primary viewing areas of television stations cite economic factors as the reasons they have not acquired a set.

Television in Rural Louisiana

Alvin L. Bertrand and Frederick L. Bates

INTRODUCTION

Few inventions have been received more enthusiastically by farm and nonfarm people alike than television. In the period 1950 to 1956, half of the farmers in the United States bought television sets.[1] The percentage of Louisiana farmers owning television sets has not been determined for a recent year, but close to two-thirds of the households in the state were equipped with sets in 1956.[2] This is a phenomenal increase in the light of the relatively high cost of television and as measured by farmers' acceptance of certain other technological innovations. The rapid increase in the use of television has placed it alongside the radio and the press as a medium by which information and ideas can be communicated to masses of rural people. In this sense it has a great potential for revolutionizing social life in rural areas of the nation.

Extension and other agricultural workers are aware of the potential of television as an educational medium and in some instances have moved into the field in an experimental way. These pioneers have found that there are many important questions which must be answered before more effective use of this means of communication can be made. The present study was designed to provide the answers to some of these questions.

In preparing this report, the authors wish to stress that television is growing at a phenomenal rate. Its dynamic nature has been described by one scholar as follows: "We are concerned with a precocious, modern prodigy whose vital statistics . . . are out of date even as they are recorded."[3] The fast-changing nature of television makes it probable that certain changes have occurred since the present survey was completed. This does not invalidate the report, as the trends and patterns described are strongly indicative of present trends and patterns. The report also provides a bench mark for later comparative studies.

---

[1] Alvin L. Bertrand, *Trends and Patterns in Levels of Living of Farm Families in the U. S.,* Washington, D.C.: Agricultural Information Bulletin 181, Agricultural Marketing Service, U.S.D.A., February 1958.

[2] *U. S. Television Households by Region, State, and County,* New York: Advertising Research Foundation, March 1956.

[3] Charles A. Siepmann, *Radio, Television, and Society,* New York: Oxford University Press, 1950, p. 317.

Objectives of the Study

The general aim of the study was to determine the effectiveness of television as an educational medium for reaching farmers and homemakers. Specific objectives were: (1) A determination of the television viewing habits of rural men and women in the state; (2) a determination of the viewing time preferences, program preferences, and other viewing preferences of this group; (3) a determination of the comparative use of television and radio by rural families. The study was also designed to shed light on certain hypotheses relating to the personal adjustment of individuals which might come about because of television. For example, insight was sought on such queries as: (1) Has television affected the routines of work and recreation of farm people? (2) Has it changed their reliance on other sources of farm and home information?

Methodology

In planning the study, it was evident that only areas within the range of television stations could be sampled. Fortunately, at the time of the study, the summer of 1956, Louisiana had seven cities with television stations. Six of these were strategically located in terms of the farm areas of the state, and it was decided to interview persons living within the viewing range of the television stations of each of these cities. The seventh city, New Orleans, was omitted because of its comparative size, its metropolitan characteristics, and its peripheral location agriculture-wise. The six cities selected—Shreveport, Monroe, Alexandria, Lake Charles, Lafayette, and Baton Rouge—were well located to represent the contrasting cultures of North and South Louisiana and the various type-of-farming areas of the state.

An area sampling procedure was selected as the most appropriate for the purposes in mind. Areas within a radius of 30 miles of each of the cities selected were plotted on a map of the state. These areas were roughly equivalent to the primary, or good reception, range of the television stations. The townships in these sectors were numbered consecutively and random sampling numbers were used to select certain townships for complete enumeration. Estimates of the proportion of the state's rural population in each sample unit served as the basis for varying the sample rate. Enough townships were selected in each area to satisfy pre-determined requirements of proportionate representation of the six sample areas in the total sample. The resources available for the study determined that approximately 600 schedules could be taken. Enumerators were instructed to call on every household in each sample township and to obtain schedules from non-television households as well as from television households. The non-owners represented a subsample planned as a control group to determine attitudes of non-television owners toward television.

Altogether, 485 persons in television households and 104 persons in non-television households were interviewed. The breakdown of the sample population by survey area for both groups is shown in Table I.

TABLE I.—Distribution of the Sample Populations by Survey Areas

Survey Areas	Persons Interviewed			
	In TV Households		In Non-TV Households	
	Number	*Percent*	*Number*	*Percent*
All Areas	485	100	104	100
Shreveport	75	16	17	16
Monroe	118	24	17	16
Alexandria	40	8	11	11
Lake Charles	33	7	12	12
Lafayette	122	25	18	17
Baton Rouge	97	20	29	28

Description of Sample Population

A brief description of the sample population is included to aid the reader in making interpretations of the data presented. Of the interviewees from television households, 183, or 38 percent, were men while 302, or 62 percent, were women. This preponderance of women reflects their more general availability for interviewing. In this regard, it was felt that housewives were more reliable sources of information regarding family television habits and, therefore, their over-representation in the sample would not present a problem. Approximately one-half of the persons from non-television households were male.

Less than one-fifth, 18 percent, of the persons interviewed from television households were Negro, but 47 percent of the interviewees from non-television households were from this racial group. The latter pattern is probably a reflection of the generally lower economic status of rural Negroes, more than anything else.

The age classes of respondents are what one might expect of adult household heads and homemakers. The concentrations are in the age groups from 20 to 50. Among non-television household interviewees the age pattern is somewhat different, with heavier concentrations in the older age classes. This phenomenon can be partly explained in terms of income and habits of older people. Table II shows the age of interviewees by 10-year intervals.

TABLE II.—Age of Interviewees in Television and Non-Television Households

Age Classes	Persons Interviewed			
	In TV Households		In Non-TV Households	
	Number	*Percent*	*Number*	*Percent*
All Persons	485	100	104	100
Under 20 years	85	17	3	3
20-29	116	24	17	16
30-39	115	24	18	17
40-49	84	17	14	14
50-59	54	11	16	15
60 and over	31	7	36	35

The interviewees' educational attainment reflects the generally low education of the rural population of the state. However, it is quite noticeable that television owners have more formal education than non-owners. Although approximately one-fifth of the persons from television households had completed less than five years of schooling, as many as two-fifths of the persons from non-television households had not gone as far in school as the fifth grade. Educational differentials are more pronounced at the high school level. Nearly two-fifths of the interviewees from television homes had at least a ninth grade education, but only a little more than one-fifth of the interviewees from non-television homes had this much schooling. (See Table III.)

TABLE III.—Educational Attainment of Interviewees in Television and Non-Television Households

Years of Schooling	Persons Interviewed			
	In TV Households		In Non-TV Households	
	Number	*Percent*	*Number*	*Percent*
All Persons	485	100	104	100
0-4	94	20	42	40
5-8	151	31	35	34
9-12	179	37	23	22
13 and over	60	12	4	4
Unknown	1	*	0	..

*Less than 1 percent.

All interviewees except 25 were heads of households or spouses of heads of households. The remainder were adult sons or daughters of heads of households.

Description of Television Sets in Rural Homes

Certain facts about the television sets owned by respondents are of interest as background information. At the time of the survey, one-eighth (12 percent) of the sets owned were less than six months old and 18 percent were from six to twelve months old. Approximately 30 percent were from one to two years old and 21 percent were two to three years of age. One out of every 10 interviewee households had a set from three to four years old, while the remainder, 9 percent, owned sets at least four years of age.

The majority (79 percent) of the sets in interviewee households had a 21-inch screen. Some 13 percent of the sets had 17-inch screens, and 5 percent had screens larger than 21 inches. Only 3 percent of the sets had screens smaller than 17 inches.

Nine out of every 10 sets were operated with outdoor antennas. Ten percent of the sets equipped with outdoor antennas had a mechanical device for rotating the antenna.

All interviewees from television homes were asked to rate the quality of the reception they experienced. Almost two-fifths (37 percent) said their reception was "very good," and 44 percent responded that their reception was "good." The judgment of about one-fifth of the interviewees was that they had only "fair" reception. Only 2 percent of the individuals in this sample group classed their reception as "poor."

TELEVISION VIEWING PATTERNS

The fact that television viewing is closely associated with the time of day is well known to all familiar with television programming. Variations in peak viewing periods are reflected in the premium prices charged to advertisers for certain "spots." In the light of this fact, it was hypothesized that the television use patterns of rural people would reflect their daily round of activity. The discovery of periods of peak viewing was one of the major aims of the present study.

In studying the findings of this survey, the reader should be aware of the fact that a "typical television day" like a "typical radio day" is a fictional representation. Viewing patterns may vary because of such things as weather conditions, special events, and news breaks, which modify programming. However, these occasional variations in program schedules have little appreciable effect on the long-time viewing patterns of rural people.

Much of the information presented is broken down by the two major cultural regions of the state. This breakdown is to make it possible for persons from North and South Louisiana to appraise their local situation with regard to television patterns, and to compare it with that of the rural population in other parts of the state and nation. Certain data are presented by sex and race because of significant differences along these lines.

Each person interviewed whose home was equipped with a television set was asked to report the times at which he or she viewed television regularly during the week, on Saturdays, and on Sundays. Their responses were recorded by quarter-hour periods (to coincide with customary program schedules) and graphed. Percentages were computed on the basis of the total number of interviewees in each sample group in each area, and comparisons and analyses were made accordingly. On the charts, each quarter-hour period is connected to the one following it by a continuous line to form a viewing curve.

Comparisons are made where possible between radio and television patterns of use. In this regard, a study made in 1948 provides information on what might be termed the pre-television, radio listening habits of rural Louisianians.[4] Questions pertaining to current radio patterns were included in the field schedule for the present study.

Weekday Viewing Patterns

The time available to farm men and women for viewing television is limited by their daily round of activities in the home and on the farm. Unlike radio, which requires the use of only the auditory sense and leaves the eye free to direct the work of the hands or the movement of the body, television requires both visual and auditory attention. This fact imposes more drastic time limits on the use of television than is true of radio.

Weekday Viewing Habits of Men

Figure I shows the weekday viewing patterns of the men in the sample areas. It can be seen that there is only one peak in their viewing curve—from 6 till 10 p.m. This is in sharp contrast to the radio listening pattern of farmers found in 1948, which had an early morning and a noon peak period as well as a late evening one. The hour between 8 and 9 p.m. on weekdays is the most popular hour for farm men to view television. During this hour, over 90 percent of the men living in television equipped homes reported watching their sets.

In contrast to the earlier observed radio listening habits of men, their television viewing builds up more gradually during the day. However, it begins to rise sharply at about the same time (between 6 and 7 p.m.) as did radio. Television tends to hold its male audience for a long-

---

[4] Alvin L. Bertrand and Homer L. Hitt, *Radio Habits in Rural Louisiana,* Baton Rouge: Louisiana Agricultural Experiment Station Bulletin No. 440, September 1949.

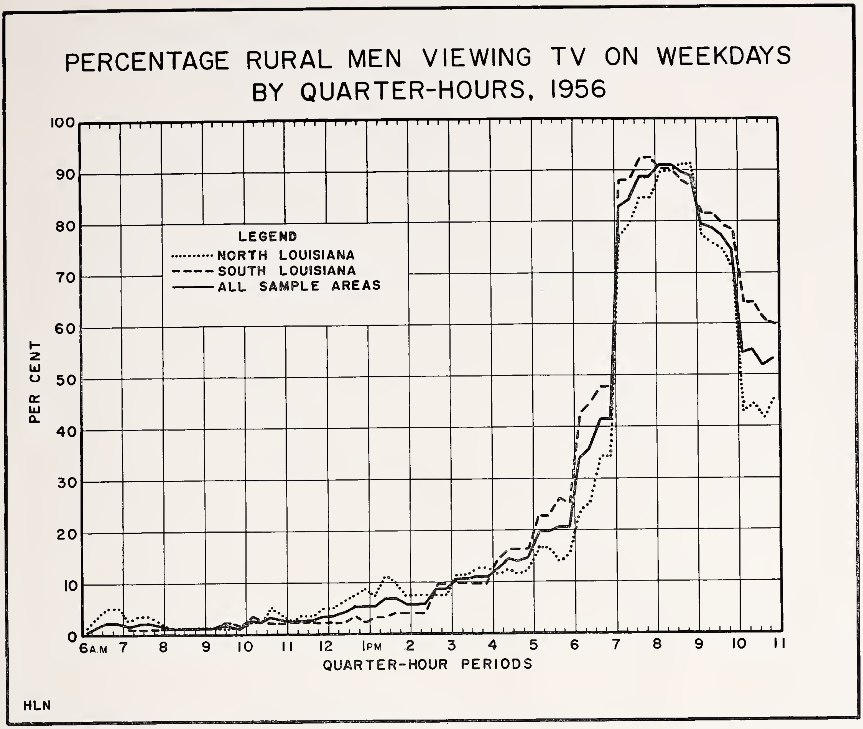


Figure 1.—Percentages of rural men from television households who reported viewing regularly at specified times on weekdays, by major cultural regions, Louisiana, 1956.

er period of time in the evening. Of the men interviewed over half reported regular viewing on weekdays between 10 and 11 p.m. In 1948 less than 10 percent of the men reported listening to the radio during the same period.

Weekday Viewing Habits of Women

Because women's work location is generally in the home, greater opportunity for television viewing exists for them. It can be seen in Figure 2 that rural women make greater use of television than rural men. In comparison with the results of the earlier study of radio listening patterns, it is apparent that the daily tasks of cooking, ironing, sewing, etc., limit housewives' use of television more than they did her use of the radio. This can be explained, of course, by the fact that radio does not require visual attention.

The peak viewing period for women, as for men, is 6 to 10 p.m. Women, however, exceed men in the rural television audience at almost every period of the day. This tendency is particularly marked between

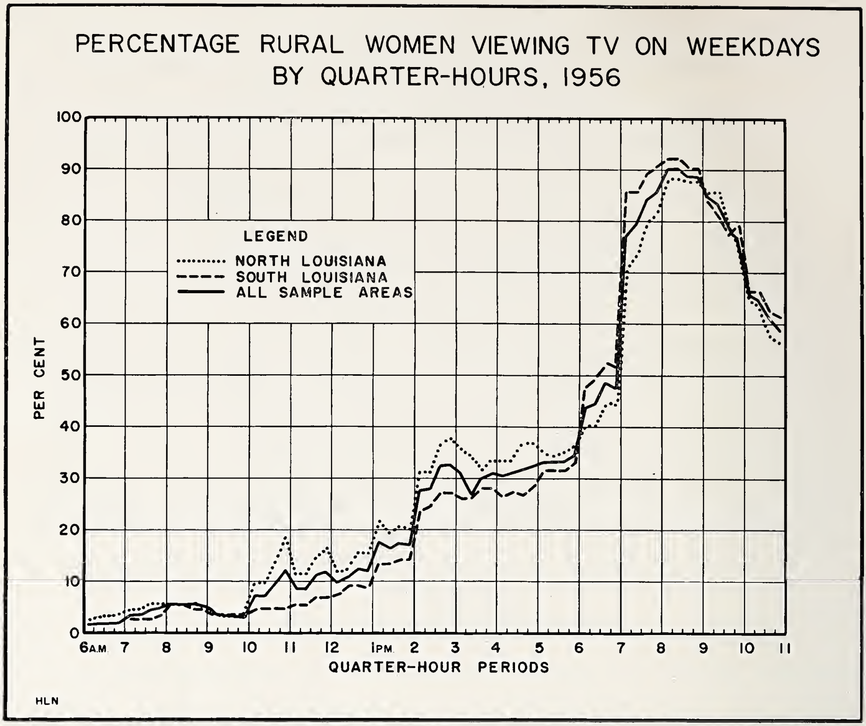


Figure 2.—Percentages of rural women from television households who reported viewing regularly at specified times on weekdays, by major cultural regions, Louisiana, 1956.

2 and 5 p.m., when from 25 to 35 per cent of the women reported television viewing as compared to 5 to 15 percent of the men.

Comparisons of the radio listening habits of women in 1948 with current television viewing habits suggest that an afternoon period of relatively close attention to television has now been substituted for, or is coupled with, an early morning period of radio listening. The report of the 1948 study indicated that between 30 and 40 percent of the women were listening to the radio during the hours between 9 a.m. and 12 noon. The present study shows that less than 10 percent of the women in the sample group watch television during those hours on the typical weekday.

An interesting difference between the television viewing habits of men and women is the tendency for women to continue viewing television later in the evening. Three out of five of the women from television homes reported watching television from 10 to 11 p.m. Slightly over half of the men reported viewing television at this time. The explanation for this pattern is not clear. It probably is related to several factors, such as the selective appeal of the type of program presented and the early morning work hours of men.

Saturday Viewing Patterns

The difference between weekdays and weekends in the work and activity patterns of rural people necessitates study of the use of television during both periods. Saturday, among rural people, has traditionally been a day when the routines of the week are abandoned and a new pattern of activity takes over. Such activities as visiting and going shopping no doubt affect television viewing habits. For this reason all informants were asked at what time they regularly used their television sets on Saturday. The responses are summarized in Figures 3 and 4.

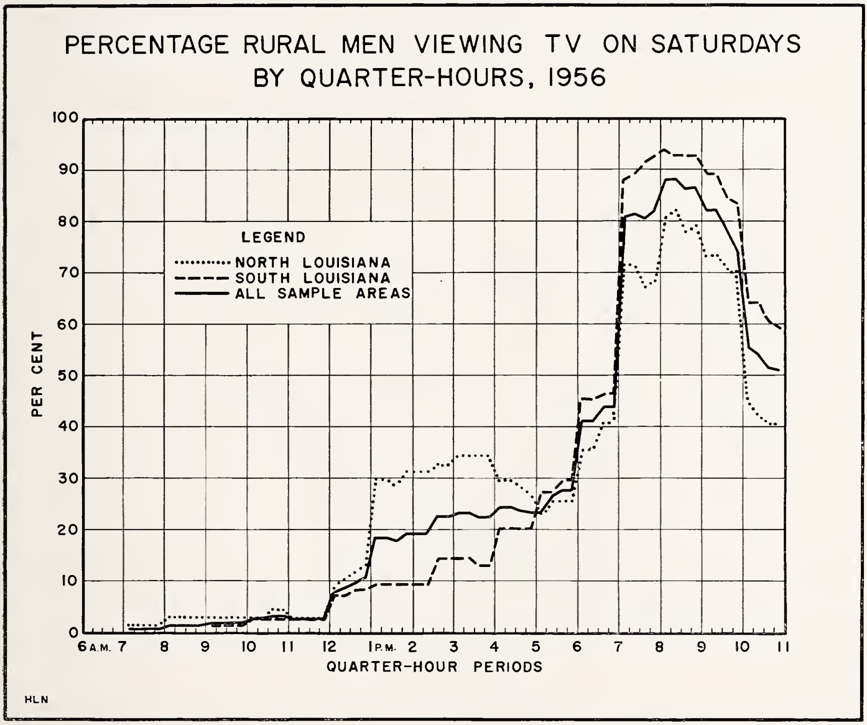


Figure 3.—Percentages of rural men from television households who reported viewing regularly at specified times on Saturday, by major cultural regions, Louisiana, 1956.

Saturday Viewing Habits of Men

It was found in the survey of radio habits made in 1948 that farmers listened to their radios more on Saturday than on weekdays and that this increased listening was primarily an evening phenomenon. Rural men used the radio less during the noon hour on Saturday than on weekdays, probably because many had gone to the community trade center.

The Saturday television viewing habits of rural men also differ somewhat from their weekday patterns. More of them use their television during the pre-evening hours—between 12 noon and 6 p.m.—on Saturday than during the week. After six o'clock on Saturday, their use of television differs only slightly from weekday patterns, but is more pronounced than their use of radio was in 1948. The reason for the latter, no doubt, is the greater recreational appeal of television which allows it to compete successfully with the movies and other forms of entertainment.

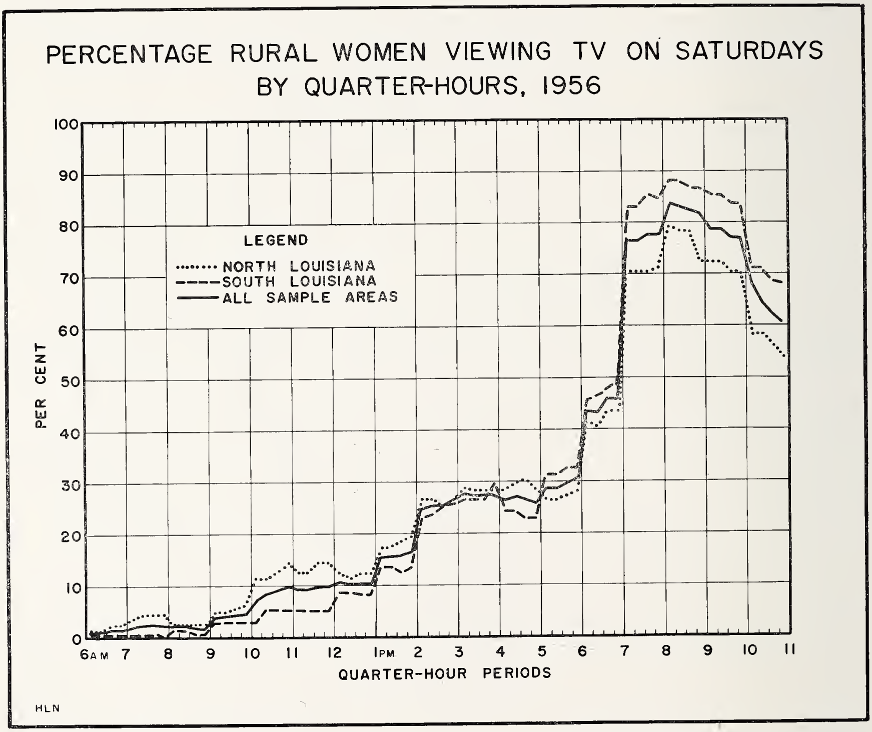


Figure 4.—Percentages of rural women from television households who reported viewing regularly at specified times on Saturday, by major cultural regions, Louisiana, 1956.

Saturday Viewing Habits of Women

The same kind of male-female differences in television viewing are observable on Saturday as were found during the week. Fewer women, however, tend to engage in television viewing on Saturday afternoon than on weekdays (about 25 percent on Saturday as compared to 30 percent on weekdays). This is in contrast to the habits of their husbands.

In the evening, after 6 p.m., relatively fewer women than men are in the television audience on Saturday. Actually, the weekday and Saturday viewing habits of both men and women differ only slightly. If a generalization can be made it would be that men tend to view television in greater relative numbers on Saturday than on weekdays while women tend toward less viewing on Saturday. A second generalization would be that there is a smaller difference between the number of men and women in the television audience on Saturday between noon and 6 p.m. than on weekdays during the same period.

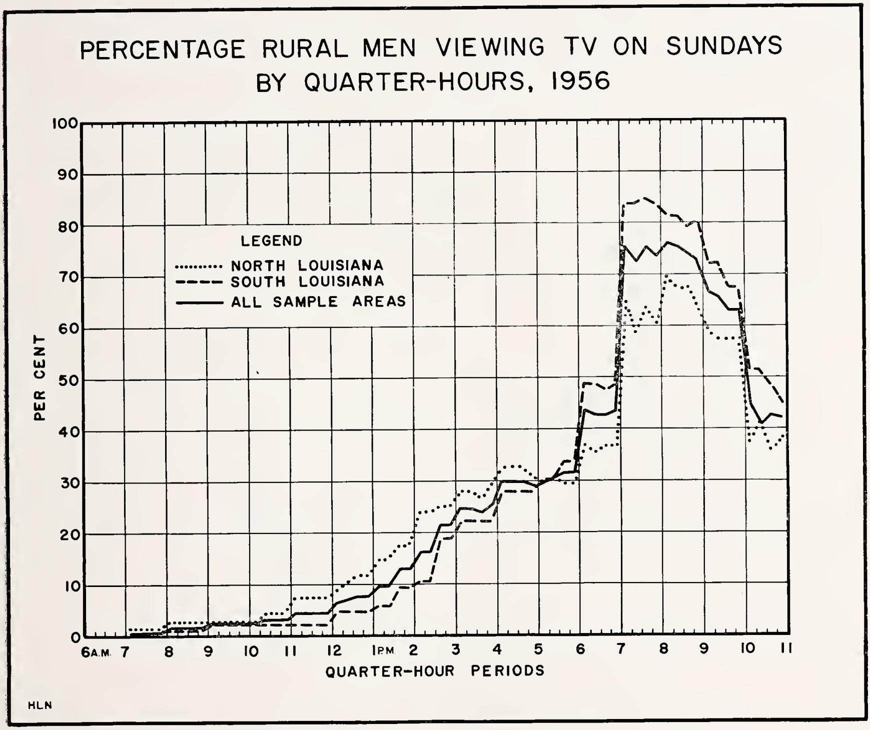


Figure 5.—Percentages of rural men from television households who reported viewing regularly at specified times on Sunday, by major cultural regions, Louisiana, 1956.

Sunday Viewing Patterns

It is logical to expect that farm men and women would devote more time to television viewing on Sunday. The responses of interviewees of both sexes to questions about their Sunday television habits are summarized in Figures 5 and 6.

Sunday Viewing Habits of Men

The fact that stands out with respect to the viewing patterns of men is that more of them use their television sets in the afternoon hours on Sundays (between 12 noon and 6 p.m.) than on weekdays or Saturdays. For example, from 5 to 40 percent of all male respondents from television homes reported viewing on Sundays as compared with 3 to 20 percent on weekdays and 5 to 30 percent on Saturdays. The men interviewed also reported less television viewing in the evening hours on Sundays than on weekdays and Saturdays. About three-fourths of them reported viewing between 8 and 9 p.m. on Sundays, while almost nine out of ten were watching their sets on weekdays and Saturdays.

Sunday Viewing Habits of Women

Women do not show as distinct a difference in viewing patterns between weekday and Sunday afternoons as do men; however, after 6 p.m.

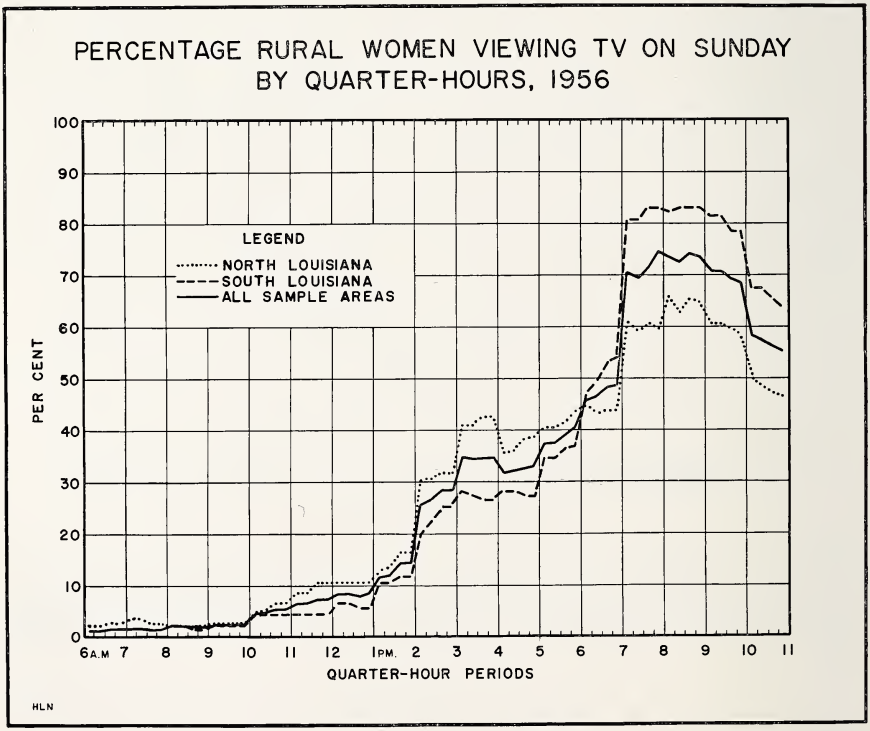


Figure 6.—Percentages of rural women from television households who reported viewing regularly at specified times on Sunday, by major cultural regions, Louisiana, 1956.

on Sundays, relatively fewer women are in the television audience than on weekdays. This difference is even more pronounced than it was for the men.

Differences Between Viewing Patterns in North and South Louisiana

Certain regional differences in television viewing patterns have already been brought out. These differences apparently relate to cultural orientations in French-South Louisiana and the remainder of the state.[5]

The major difference in television viewing patterns in North and South Louisiana is in time preferences. In general, North Louisianians of both sexes make more relative use of television before 6 p.m. than do South Louisianians. However, after this time, there are proportionately more rural adults in the television audiences in South Louisiana than in the northern part of the state. This pattern holds true for all days of the week, although it is considerably more pronounced on weekends. For example, on Sundays well over 80 percent of the interviewees from television homes in South Louisiana reported watching their sets between 7 and 10 p.m., but only slightly over 60 percent of the North Louisiana respondents said they were so engaged at this time. Differences in church attendance practices in predominantly Catholic and in predominantly Protestant areas explain these variations, at least partially, on Sunday. The reason for similar differences on Saturdays and weekends is not clear. Intimate knowledge of the cultures involved suggests that one factor might be that television holds a somewhat greater recreational value for South Louisianians.

TELEVISION PROGRAM PREFERENCES

Each person interviewed was asked to list his or her favorite television programs in order of preference. They were also asked to specifically indicate the time they devoted to farm and home telecasts and the time they would prefer to view this type of program. Their comments are summarized in this section.

The first and second television program preferences expressed by interviewees were combined and classified according to program type to form a simple index of their over-all likes and dislikes. To illustrate this procedure, 11 of the 183 men expressed a first choice for "drama" programs and 5 expressed a second choice for this type of program. Altogether, 16 expressed a first and second choice, and this number represented 9 percent of all the men interviewed. These are the numbers and percentages which appear in Table IV.

---

[5] See: Alvin L. Bertrand, *The Many Louisianas: Rural Social Areas and Cultural Islands*, Baton Rouge: Louisiana Agricultural Experiment Station Bulletin No. 496, June 1955.

TABLE IV.—Television Program Preferences of Interviewees, by Sex

Type Program	First and Second Program Preferences			
	Males		Females	
	Number	*Percent**	*Number*	*Percent**
Drama	16	8.7	40	13.2
Mystery	39	21.3	92	30.4
Comedy	50	27.3	115	38.0
News	14	7.7	18	6.0
Music	3	1.6	2	.7
Religion	5	2.7	7	2.3
Infor. & Educ.	3	1.6	15	5.0
Sports	88	48.1	25	8.3
Serials	3	1.6	45	14.9
Variety	14	7.7	34	11.3
Quiz	18	9.8	57	18.9
Movie Plays	0	. .	4	1.3
Panels	6	3.3	12	4.0
Children	2	1.1	5	1.7
Westerns	40	21.9	45	14.9
Give Away	7	3.8	33	10.9
Hill Billy Music	2	1.1	7	2.3
Others	4	2.2	2	.7
No Answer	52	28.5	46	15.2

*Percentages show the percentage of interviewees expressing a first or second choice and therefore do not add to 100.

It is apparent that sports telecasts were the most popular television programs with men. Comedy programs were second in order of male preference, and "Westerns" were third. In contrast, the first preference of the women interviewed was for comedy programs, while their second choice, interestingly, was mystery programs. "Quiz shows" ranked third as a program preference of this sex group. Approximately 15 percent of the women expressed keen interest in "Westerns" and only 8 percent placed sports broadcasts among their first or second program preferences.

Significantly, the above findings suggest that quite different television preference patterns prevail for rural women and men. This fact leads to speculation regarding the prevalence of conflict situations and authority patterns related to the use of this innovation.[6]

INTERESTS AND PREFERENCES RELATING TO AGRICULTURAL TELECASTS

The responses of informants show that informational and educational programs rank low among the general viewing preferences of rural men and women. This is understandable in terms of the specialized and non-entertainment orientation of these telecasts. It is perhaps significant that any rural viewer would rate them as his first or second choice for a program.

---

[6] For a discussion of status and role and how they relate to power and conflict, see: Kingsley Davis, *Human Society,* New York: The Macmillan Co., 1949, pp. 83-117.

The Agricultural Program Audience

It should be encouraging to agricultural workers to learn that more than three-fifths of both the male and female respondents regularly viewed agricultural programs, even though they ranked informational and educational programs low in terms of their over-all program preferences.[7]

When men and women were asked about their preferences for future agricultural and homemaking broadcasts a rather general picture emerged. Men in the sample group expressed their strongest preference for programs on farm enterprises, mentioning crops, livestock, poultry, and dairying topics in that order. Other farm topics such as farm management, soil conservation, disease and pest control were also mentioned, but not as prominently. The women interviewed expressed strongest interest in programs dealing with cooking or food preservation. Their second preference was for information on sewing and handicraft work.

The findings with regard to agricultural programs make clear the importance of careful planning for telecasts devoted to agricultural topics.

Television as the Preferred Medium for Farm News and Market Reports

It is of value to agricultural workers to know which communication medium is preferred as a source of farm news and market reports. For this reason respondents were asked what communication source they preferred for such information. The answers have been tabulated and are presented in Table V.

The great majority of both races and sexes preferred television as a source of farm news and market information. This preference is so preponderant as not to need further elaboration.

Time Preference for Farm and Home Programs

In order to determine the time preferences of rural people for farm and home telecasts, respondents were asked to indicate which hours of the day they would prefer such programs to be scheduled.

---

[7] A study by Charles B. "Ted" Carroll, Caddo Parish County Agent, of the rural audience for his extension television program validates this finding. Carroll concludes that the daily county agent television program is justifiable on the basis of its audience follow-through. This study is recommended to all agricultural workers of the state who are interested in reaching the masses of rural people. (Unpublished term paper submitted to Dr. Malcolm C. Gaar, Professor, Vocational Agricultural Education, Louisiana State University.)

TABLE V.—Interviewees' Preferred Source of Farm News and Market Information, by Race and Sex

Preferred Source of Farm and Market News	White				Nonwhite			
	Male		Female		Male		Female	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
All Persons	149	100	249	100	34	100	53	100
TV	131	88	208	84	30	88	44	83
Radio	11	8	15	6	1	3	5	9
Other	5	3	13	5	0	.	3	6
No Answer	2	1	13	5	3	9	1	2

By far the most popular time for such telecasts is between 6 and 8 p.m. in the evening. Approximately 45 percent of the interviewees expressed a preference for this time. The noon hour is the next most popular time period among rural viewers, and the early morning hours prior to 8 a.m. are third in order of preference. Seasonal variations in time preferences indicate an inclination to favor the evening hours in the fall and winter and the noon hour during the spring and summer. These variations are only minor, however, and time preferences seem to remain fairly consistent throughout the year. Apparently the least desirable time for telecasts to rural areas is the period between 8 a.m. and noon.

THE IMPACT OF TELEVISION ON SELECTED LEISURE-TIME ACTIVITIES

Many studies have shown that television has revolutionized the leisure-time activities of those who have access to this medium of communication.[8] The findings of the present study show that farm people, like their urban cousins, have changed certain of their recreational and educational activities because of television. These changes are described in the discussion which follows.

Changes in Radio Listening Habits

Each respondent was asked whether or not television had changed his or her radio listening habits. These responses are summarized by race and sex in Table VI. In this connection, it is important to know that 95 percent of the interviewee households equipped with TV also had a radio set.

---

[8] Leo Bogart, *The Age of Television, A Study of Viewing Habits and the Impact of Television on American Life,* New York: Frederick Ungar Publishing Company, 1956.

TABLE VI.—Interviewees Changing Their Radio Listening Habits Because of Television, by Sex and Race

Radio Habits Changed by TV?	White				Nonwhite			
	Male		Female		Male		Female	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
All Persons	149	100	249	100	34	100	53	100
Yes	102	68	182	73	21	62	38	72
No	46	31	67	27	11	32	15	28
No Answer	1	1	..	..	2	6	..	..

The majority of respondents of both sexes and races said that television had altered their radio listening habits. However, the various sex and race subgroups have been affected differently. More women than men answered that their habits had been changed, a finding which seems to relate to type and place of work. Fewer Negroes than whites said that their habits had been changed. This difference is believed to be the partial consequence of radio stations in the sample areas which cater to the Negro audience. No television stations are selective in their programming in this way.

Television apparently has drastically altered the times during which radio is used. This fact was indicated in the preceding discussions comparing television and radio listening habits of rural Louisianians. Respondents reported their radio listening is now concentrated in the morning hours, with the highest percentage listening between 6 a.m. and 9 a.m. This pattern can be understood since many television stations are not on the air at this time and because it is a period of activity in the home and on the farm. During the rest of the day radio listening declines steadily. From noon to 2 p.m. only 14 percent of the respondents reported listening to the radio, but 50 percent of them reported viewing television. After 7 p.m., only 9 percent of the respondents who owned television sets reported listening to the radio regularly, while 96 percent reported looking at television some time during the evening.

The above makes it clear that there are definite patterns for the use of television and radio in the home equipped with both. When it is a matter of choice, television will usually take precedence over the radio.[9] Thus radio has its peak use in the early morning and its low period of use in the late evening, with television use being just the reverse.

To further explore this phenomenon, all respondents were asked to list their radio program preferences. A basic finding as a result of this query was that many persons either did not listen to their radios or allocated very little time to them. The majority of both men and women who had definite radio program preferences said they had a first preference for news and weather broadcasts and a second preference for musical programs. Religious programs were favored by the third largest percentage of respondents.

---

[9] The same effect of TV on radio listening was reported in a study of a rural area in Missouri. Herbert F. Lionberger, *Television Viewing in Rural Boone County*, Columbia: Missouri Agricultural Experiment Station Bulletin No. 702, 1958.

Changes in Movie Attendance and Reading Habits

Movie attendance in rural areas seems to have decreased considerably with the advent of television. Over half of the respondents said that television had affected their movie attendance habits. Females of both races reported their movie habits had changed in greater relative numbers than males. (See Table VII.)

TABLE VII.—Interviewees Changing Their Movie Habits Because of Television, by Sex and Race

Movie Habits Changed by TV?	White				Nonwhite			
	Male		Female		Male		Female	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
All Persons	149	100	249	100	34	100	53	100
Yes	87	58	151	61	16	47	26	49
No	60	41	98	39	16	47	27	51
No Answer	2	1	0		2	6	0	

Changes in reading habits were also attributed to television. As many as two-fifths of the respondents of both sexes and races said their reading habits had been affected.

The majority of those persons indicating how their reading habits had changed said they read less than before or now confined their reading almost wholly to newspapers. This finding has significance for farm and home agents, in terms of the dissemination of information to farm men and women.

In conclusion, it may be noted that the patterns described above are similar to the findings of numerous studies. The reader interested in summaries of these studies is referred to the publications of the National Project in Agricultural Communications, Michigan State University, East Lansing, Michigan, and to the publications of the Division of Field Studies and Training of the Federal Extension Service, Washington 25, D. C.

NON-OWNERS' USE OF TELEVISION AND THEIR FEELINGS ABOUT IT

It was brought out in the introductory section of this report that 104 persons from non-TV households were interviewed. These persons were asked certain questions to determine their use of and feelings about this new means of communication. Their responses to the questions asked are summarized below.

The first question asked of non-owners was whether they viewed TV regularly at some nearby place. Interestingly, as many as two-fifths of them said they did. Those answering this question in the affirmative were questioned further to find out where they viewed. All except six of the 41 persons involved said they went to a friend's or a relative's home nearby. The six others were in the habit of going to a commercial establishment featuring TV for their viewing.

A further question asked non-owners dealt with their plans for purchasing sets in the future. Since all respondents lived within the primary broadcast range of at least one TV station, the factor of reception was not a critical one. Nearly one-third of this sample group reported they had thought of buying or were planning to buy a television set. Those persons saying they were not planning to do so were queried as to the reason for their not planning to get sets. The great majority of this group cited economic reasons for their answer. In their words they "couldn't afford one" or "didn't have the money." Only five persons exhibited attitudes which were definitely negative to TV. These five claimed they "didn't need" or "didn't want" a television set.

It is of interest that 93 percent of the non-TV owners did have a radio in their homes. This fact indicates that they have experience with a mass media type of communication and suggests that they might acquire television sets when conditions permit.

630.7
L93b

BULLETIN NO. 519 DECEMBER 1958

Agricultural Statistics For Louisiana, 1909-1957

by

J. P. MONTGOMERY

TATE UNIV
LIBRARY
LOUISIANA

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
CHARLES W. UPP, *Director*

CONTENTS

Page

Introduction 6

Population estimates, by residence, and percentage ratios of farm population and farm income to national totals, 1910-56, Table 1 7

Income of farm and factory workers, United States, 1910-56, Table 2 8

Average per capita net income, by residence and by source of income, United States, 1910-56, Table 3 9

National income and income of the nonfarm population, by source, United States, 1910-56, Table 4 10

Realized gross income and net income of farm operators from farming, Louisiana, 1949-57, Table 5 11

Distribution of crop acreage by crop reporting districts, 1954 census, Table 6 12

Farms, farm property and farm population, 1910-55 Censuses, Table 7 13

Acres of land used in the production of selected crops, Louisiana, 1909-57, Table 8 14

Louisiana's rank in volume of production among the states in crops and livestock, 1950-57, Table 9 20

Rank in cash receipts of crops, livestock and livestock products in Louisiana, 1950-57, Table 10 21

Cash receipts from farm marketings, value of products consumed in farm household, and government payments, 1924-57, Table 11 22

Cash receipts from farm marketings by commodities, 1939-57, Table 12 24

Cattle and calves: January 1 inventory, calf crop, and disposition, 1924-58, Table 13 25

Cattle and calves: Production, marketings, price, and income, 1924-57, Table 14 26

Cattle slaughter: Number of head, by months, January 1946-August 1958, Table 15 27

Calf slaughter: Number of head, by months, January 1946-August 1958, Table 16 27

Cattle slaughter: Average live weight per head, by months, January 1947-August 1958, Table 17 28

Calf slaughter: Average live weight per head, by months, January 1947-August 1958, Table 18 28

Cattle slaughter: Total live weight, by months, January 1947-August 1958, Table 19 29

Calf slaughter: Total live weight, by months, January 1947-August 1958, Table 20 29

Cattle: Number on farms, value per head, and farm value, January 1, 1909-58, Table 21 30

Cattle: Number on farms, by classes, 1920-58, Table 22 32

Dairy products: Production, disposition, and income, 1924-57, Table 23 34

Dairy products: Farm marketings, price, and value, 1924-57, Table 24 36

CONTENTS (Continued)

Page

Hogs and pigs: Number on farms, value per head, and farm value, January 1, 1909-58, Table 25 37

Hogs: January 1 inventory, pig crop, and disposition, 1924-58, Table 26 38

Hogs: Production, marketing, price, and income, 1924-57, Table 27 39

Hog slaughter: Number of head, by months, January 1946-August 1958, Table 28 40

Hog slaughter: Average live weight per head, by months, January 1947-August 1958, Table 29 40

Hog slaughter: Total live weight, by months, January 1947-August 1958, Table 30 41

Sheep and lambs: Number on farms, value per head, and farm value, January 1, 1909-58, Table 31 42

Sheep and lambs: January 1 inventory, lamb crop, and disposition, 1924-58, Table 32 43

Sheep and lambs: Number on farms, by classes, January 1, 1920-58, Table 33 44

Sheep and lambs: Production, marketings, price, and income, 1924-57, Table 34 45

Sheep and lamb slaughter: Number of head, by months, January 1946-August 1958, Table 35 46

Sheep and lamb slaughter: Average live weight per head, by months, January 1947-August 1958, Table 36 46

Sheep and lamb slaughter: Total live weight, by months, January 1947-August 1958, Table 37 47

Wool: Production, price, and value, 1909-58, Table 38 48

Workstock: Number on farms, value per head, and total value, 1910-58, Table 39 49

Horses and mules: Number on farms, by classes, January 1, 1910-58, Table 40 50

All chickens: Number on farms, value per head, and farm value, January 1, 1924-58, Table 41 51

Farm chickens: January 1 inventory, production, disposition, price, and income, 1924-58, Table 42 52

Chicks hatched in commercial hatcheries, by months, January 1938-September 1958, Table 43 53

Commercial broilers: Production, price, and value, 1934-57, Table 44 54

Broilers: Egg set and chicks placed, by months, October 1954-September 1958, Table 45 55

Turkeys: Number on farms, value per head, and farm value, January 1, 1929-58, Table 46 56

Turkeys: January 1 inventory, production, disposition, price, and income, 1929-58, Table 47 57

Eggs: Production, disposition, price, and value, 1924-57, Table 48 .. 58

Eggs: Monthly production, January 1925-September 1958, Table 49 60

Honey bees: Number of colonies, production, price, and value of honey and beeswax, 1937-58, Table 50 61

CONTENTS (Continued)

Page

Package bees: Colonies for production of package bees, package bees shipped, and queen bees shipped, 1944-51, Table 51 61

Cotton lint: Acreage, yield, production, price, and value, 1909-58, Table 52 62

Cottonseed: Acreage, yield, production, price, and value, 1909-57, Table 53 64

Rice: Acreage, yield, production, price, and value, 1909-58, Table 54 66

Sugar cane (for sugar and seed): Acreage, yield, production, price, and value, 1909-58, Table 55 68

Sugar cane (for sugar): Acreage, yield, production, price, and value, 1909-57, Table 56 69

Sugar cane (for sirup): Acreage, yield, production, price, and value, 1909-57, Table 57 70

Corn: Acreage, yield, production, price, and value, 1909-58, Table 58 72

Corn: Production, farm disposition, and value, 1909-58, Table 59 74

Corn: Acreage planted with hybrid seed, 1938-58, Table 60 75

Oats: Acreage, yield, production, price, and value, 1909-58, Table 61 76

Soybeans (for beans): Production, disposition, price, and value, 1924-58, Table 62 78

Soybeans (for beans): Production, disposition, price, and value, 1924-58, Table 63 79

Soybeans: Acreage for all purposes, 1924-58, Table 64 80

Cowpeas (for peas): Acreage, yield, production, price, and value, 1924-57, Table 65 81

Cowpeas: Acreage for all purposes, 1924-57, Table 66 82

Cowpeas (for peas): Production, disposition, price, and value, 1924-57, Table 67 83

Velvet beans: Acreage, yield, production, price, and value, 1924-52, Table 68 84

All hay: Acreage, yield, production, price, and value, 1909-58, Table 69 85

Annual legume hay: Acreage, yield, and production, 1919-52, Table 70 87

Hay (alfalfa, lespedeza, and miscellaneous): Acreage, yield, and production, 1919-58, Table 71 88

Lespedeza seed: Acreage, yield, production, price, and value, 1924-51, Table 72 90

White clover seed: Acreage, yield, production, price, and value, 1930-58, Table 73 91

Peanuts (picked and threshed): Acreage, yield, production, price, and value, 1909-52, Table 74 92

Irish potatoes (all): Acreage, yield, production, price, and value, 1909-58, Table 75 93

Sweetpotatoes: Acreage, yield, production, price, and value, 1909-58, Table 76 95

Strawberries: Acreage, yield, production, price, and value, 1918-58, Table 77 97

CONTENTS (Continued)

Page

Peaches: Production, price, and value, 1909-58, Table 78 98
Pears: Production, price, and value, 1909-58, Table 79 99
Oranges: Production, disposition, price, and value, 1919-57, Table 80 100
Watermelons (market): Acreage, yield, production, price, and value, 1934-58, Table 81 101
Tomatoes (market): Acreage, yield, production, price, and value, 1925-58, Table 82 102
Cabbage (market): Acreage, yield, production, price, and value, 1918-58, Table 83 103
Snap beans (mid-spring market): Acreage, yield, production, price, and value, 1918-58, Table 84 104
Snap beans (early fall market): Acreage, yield, production, price, and value, 1922-58, Table 85 105
Onions (market): Acreage, yield, production, price, and value, 1918-52, Table 86 106
Shallots (spring market): Acreage, yield, production, price, and value, 1937-58, Table 87 107
Shallots (winter market): Acreage, yield, production, price, and value, 1937-58, Table 88 107
Garlic (market): Acreage, yield, production, price, and value, 1932-52, Table 89 108
Green peppers (market): Acreage, yield, production, price, and value, 1924-58, Table 90 109
Carrots (market): Acreage, yield, production, price, and value, 1923-52, Table 91 110
Cucumbers (early fall market): Acreage, yield, production, price, and value, 1928-58, Table 92 111
Cucumbers (late spring market): Acreage, yield, production, price, and value, 1923-58, Table 93 112
Spinach (market): Acreage, yield, production, price, and value, 1925-52, Table 94 113
Eggplant (market): Acreage, yield, production, price, and value, 1925-52, Table 95 114
Beets (market): Acreage, yield, production, price, and value, 1927-52, Table 96 115
Vegetables for commercial processing: Acreage, production, price, and value, 1928-57, Table 97 116
Pecans (improved and seedling): Production, price, and value, 1919-58, Table 98 117
Tung nuts: Production, price, and value, 1939-57, Table 99 119
Tobacco (perique): Acreage, yield, production, price, and value, 1919-58, Table 100 120

Agricultural Statistics for Louisiana
1909 - 1957

J. P. Montgomery
Department of Agricultural Economics
Louisiana Agricultural Experiment Station

This publication brings up to date the data originally released in "Agricultural Statistics for Louisiana, 1909-1953."[1] Some of the data published in the original and in the revised bulletins have been omitted in this report while other data have been added.

The purpose of this publication is to make available to the people of Louisiana the basic statistical data most frequently sought about our primary industry—agriculture.

The compilations in this report were made from releases by the Louisiana Cooperative Crop Reporting Service and other releases by the United States Department of Agriculture. The Crop Reporting Service in Louisiana represents both the United States Department of Agriculture and Louisiana State University. Formal cooperation exists between the Department of Agricultural Economics of the University and the Louisiana Office of Agricultural Estimates, Agricultural Marketing Service, United States Department of Agriculture.

The cooperative agencies are grateful to the thousands of persons throughout Louisiana who cooperate without pay as voluntary crop, livestock and price reporters. These voluntary reporters are the key to timely and accurate information on agricultural production and prices.

This report makes the data on Louisiana agriculture more readily available to agricultural workers and others affected by changes in agricultural conditions. The publication comprises statistics on the more important agricultural enterprises and products in Louisiana from 1909 through 1957. Attempt has been made to organize in tables, the data that will be of the greatest value to those in need of information on Louisiana's agriculture in time series.

---

[1] Louisiana Bulletin No. 444, June 1950, and Louisiana Bulletin No. 490, May 1954, by J. P. Montgomery.

Table 1--Population estimates by residence and percentage ratios of farm population and farm income to national totals, 1910-56

Year	Population, annual average			Farm as percentage of total population	Farm as percentage of national income		
					Net income originating in agriculture	Net income of farm population	
	Farm	Nonfarm	Total			From agricultural sources	From all sources
	Thousands	Thousands	Thousands	Percent	Percent	Percent	Percent
1910	32,077	60,330	92,407	34.7	16.3	14.1	--
1911	32,110	61,758	93,868	34.2	14.4	12.0	--
1912	32,210	63,121	95,331	33.8	16.5	14.2	--
1913	32,270	64,957	97,227	33.2	13.6	11.3	--
1914	32,320	66,798	99,118	32.6	15.3	12.8	--
1915	32,440	68,109	100,549	32.3	14.9	12.4	--
1916	32,530	69,436	101,966	31.9	13.8	11.3	--
1917	32,430	70,984	103,414	31.4	19.2	16.4	--
1918	31,950	72,600	104,550	30.6	19.2	16.4	--
1919	31,200	73,863	105,063	29.7	17.6	14.9	--
1920	31,974	74,492	106,460	30.0	14.0	11.9	--
1921	32,123	76,418	108,541	29.6	9.2	7.0	--
1922	32,109	77,946	110,055	29.2	10.6	8.3	--
1923	31,490	80,460	111,950	28.1	10.3	8.2	--
1924	31,177	82,936	114,113	27.3	10.2	8.0	--
1925	31,190	86,642	115,832	26.9	11.9	9.9	--
1926	30,979	86,420	117,399	26.4	10.2	8.4	--
1927	30,530	88,508	119,038	25.6	10.2	8.3	--
1928	30,548	89,953	120,501	25.4	10.2	8.4	--
1929	30,580	91,190	121,770	25.1	9.8	8.1	--
1930	30,529	92,548	123,077	24.8	8.4	6.7	--
1931	30,845	93,195	124,040	24.9	8.2	6.6	--
1932	31,388	93,452	124,840	25.1	7.6	5.8	--
1933	32,393	93,186	125,579	25.8	9.4	7.4	--
1934	32,305	94,069	126,374	25.6	8.7	6.9	10.8
1935	32,161	95,089	127,250	25.3	12.0	10.3	13.8
1936	31,737	96,316	128,053	24.8	9.3	7.7	11.3
1937	31,266	97,559	128,825	24.3	10.8	9.4	12.9
1938	30,980	98,845	129,825	23.9	9.2	7.8	11.3
1939	30,840	100,040	130,880	23.6	8.8	7.4	10.9
1940	30,547	101,575	132,122	23.1	8.2	6.8	10.3
1941	30,273	103,129	133,402	22.7	9.2	7.8	11.1
1942	29,234	105,626	134,860	21.7	10.2	8.9	12.0
1943	26,681	110,058	136,739	19.5	9.8	8.6	11.3
1944	25,495	112,902	138,397	18.4	9.1	8.0	10.6
1945	25,295	114,633	139,928	18.1	9.5	8.3	10.8
1946	26,483	114,906	141,389	18.7	11.2	9.9	12.4
1947	27,124	117,002	144,126	18.8	10.7	9.4	12.0
1948	25,903	120,728	146,631	17.7	10.6	9.4	11.9
1949	25,954	123,234	149,188	17.4	8.3	7.2	9.7
1950	25,058	126,625	151,683	16.5	8.1	7.0	9.4
1951	24,160	130,200	154,360	15.7	8.2	7.2	9.4
1952	24,283	132,745	157,028	15.5	7.4	6.4	8.7
1953	22,679	136,957	159,636	14.2	6.3	5.4	7.6
1954	21,890	140,527	162,417	13.5	6.1	5.2	7.3
1955	22,158	143,112	165,270	13.4	5.4	4.6	6.7
1956	22,257	145,917	168,174	13.2	5.1	4.3	6.4

Source: Major Statistical Series of the United States Department of Agriculture, Volume 3 - Gross and Net Farm Income, Agriculture Handbook No. 118, Table 26.

Table 2--Income of farm and factory workers, United States, 1910-56

Year	Farm workers				Factory workers			
	Net income from farming	Number	Average annual farm income		Average annual wage		Average hourly earnings	
			Amount	1910-14=100	Amount	1910-14=100	Amount	1910-14=100
	Million dollars	Thousands	Dollars		Dollars		Dollars	
1910	4,701	13,555	347	103	552	100	0.200	95
1911	4,360	13,539	322	95	531	96	.200	95
1912	4,619	13,559	341	101	544	98	.210	100
1913	4,750	13,572	350	103	571	103	.220	104
1914	4,493	13,580	331	98	573	103	.223	106
1915	4,708	13,592	346	102	561	101	.230	109
1916	5,711	13,632	419	124	644	116	.260	123
1917	8,345	13,568	615	182	766	138	.310	147
1918	10,277	13,391	767	227	971	175	.400	190
1919	11,009	13,243	831	246	1,148	207	.477	226
1920	8,860	13,432	660	195	1,368	247	.555	264
1921	5,057	13,398	377	111	1,153	208	.515	245
1922	5,528	13,337	414	122	1,119	202	.487	231
1923	6,324	13,162	480	142	1,239	224	.522	248
1924	6,548	13,031	502	148	1,244	224	.547	260
1925	7,600	13,036	583	172	1,267	229	.547	260
1926	7,230	12,976	557	165	1,282	231	.548	260
1927	7,156	12,642	566	167	1,286	232	.550	261
1928	7,116	12,691	561	166	1,298	234	.562	267
1929	7,564	12,763	593	175	1,302	235	.566	269
1930	5,700	12,497	456	135	1,209	218	.552	262
1931	3,800	12,745	298	88	1,085	196	.515	245
1932	2,597	12,816	203	60	887	160	.446	212
1933	3,384	12,739	266	79	870	157	.442	210
1934	4,550	12,627	360	106	957	173	.532	253
1935	5,380	12,733	423	125	1,047	189	.550	261
1936	6,006	12,331	487	144	1,133	204	.556	264
1937	6,220	11,978	519	153	1,251	226	.624	296
1938	5,252	11,622	452	134	1,160	209	.627	298
1939	5,382	11,338	475	140	1,241	224	.633	301
1940	5,318	10,979	484	143	1,310	236	.661	314
1941	7,402	10,669	694	205	1,538	278	.729	346
1942	10,456	10,504	995	294	1,906	344	.853	405
1943	13,902	10,446	1,331	394	2,243	405	.961	456
1944	14,419	10,219	1,411	417	2,396	432	1.019	484
1945	15,149	10,000	1,515	448	2,308	416	1.023	486
1946	17,544	10,295	1,704	504	2,279	411	1.086	516
1947	19,999	10,382	1,926	569	2,598	469	1.237	587
1948	18,959	10,363	1,829	541	2,815	508	1.350	641
1949	16,538	9,964	1,660	491	2,856	515	1.401	665
1950	15,607	9,342	1,671	494	3,085	557	1.465	696
1951	17,733	8,985	1,974	584	3,365	607	1.590	755
1952	17,057	8,669	1,968	582	3,534	638	1.670	793
1953	16,672	8,580	1,943	575	3,728	673	1.770	840
1954	14,904	8,451	1,764	522	3,737	674	1.810	859
1955	14,317	8,237	1,738	514	3,979	718	1.880	893
1956	14,860	7,869	1,888	558	4,159	750	1.980	940

Source: Major Statistical Series of the United States Department of Agriculture, Volume 3 - Gross and Net Farm Income, Agriculture Handbook No. 118, Table 28.

Table 3—Average per capita net income by residence and by source of income, United States, 1910-56

	Farm population						Nonfarm population			
	From agricultural sources				From all sources					
Year	Excluding Government payments	Government payments	Total	From nonagricultural sources	Amount	Percentage of nonfarm average	From agricultural sources	From nonagricultural sources	From all sources	Total population from all sources
	Dollars	Dollars	Dollars	Dollars	Dollars	Percent	Dollars	Dollars	Dollars	Dollars
1910	147	0	147	--	--	--	12	--	--	360
1911	121	0	121	--	--	--	12	--	--	345
1912	154	0	154	--	--	--	13	--	--	367
1913	132	0	132	--	--	--	13	--	--	386
1914	145	0	145	--	--	--	13	--	--	368
1915	148	0	148	--	--	--	14	--	--	384
1916	157	0	157	--	--	--	16	--	--	443
1917	278	0	278	--	--	--	22	--	--	529
1918	305	0	305	--	--	--	23	--	--	567
1919	322	0	322	--	--	--	25	--	--	643
1920	282	0	282	--	--	--	22	--	--	711
1921	129	0	129	--	--	--	17	--	--	546
1922	158	0	158	--	--	--	18	--	--	554
1923	187	0	187	--	--	--	19	--	--	640
1924	182	0	182	--	--	--	19	--	--	624
1925	243	0	243	--	--	--	17	--	--	659
1926	220	0	220	--	--	--	17	--	--	689
1927	215	0	215	--	--	--	17	--	--	665
1928	224	0	224	--	--	--	17	--	--	676
1929	230	0	230	--	--	--	16	--	--	715
1930	166	0	166	--	--	--	14	--	--	613
1931	129	0	129	--	--	--	10	--	--	484
1932	80	0	80	--	--	--	8	--	--	345
1933	90	3	93	--	--	--	9	--	--	323
1934	94	12	106	59	165	35.3	9	459	468	391
1935	167	15	182	62	244	47.2	10	507	517	448
1936	148	8	156	72	228	38.5	10	582	592	502
1937	207	9	216	80	296	46.1	10	632	642	558
1938	153	12	165	74	239	40.6	9	580	589	506
1939	147	21	168	81	249	39.8	10	616	626	537
1940	153	21	174	88	262	38.2	10	675	685	588
1941	230	16	246	103	349	42.4	13	810	823	715
1942	360	19	379	130	509	49.2	16	1,018	1,034	920
1943	476	21	497	157	654	52.7	17	1,223	1,240	1,126
1944	497	27	524	172	696	52.4	17	1,311	1,328	1,211
1945	528	26	554	166	720	54.9	17	1,295	1,312	1,205
1946	605	26	631	162	793	61.3	20	1,274	1,294	1,200
1947	631	10	641	181	822	59.0	21	1,372	1,393	1,286
1948	752	9	761	197	958	62.8	21	1,505	1,526	1,425
1949	558	6	564	201	765	51.0	20	1,480	1,500	1,372
1950	607	10	617	211	828	52.6	19	1,556	1,575	1,451
1951	735	10	745	232	977	56.0	20	1,725	1,745	1,625
1952	692	10	702	251	953	52.0	20	1,813	1,833	1,697
1953	657	8	665	265	930	49.6	18	1,857	1,875	1,741
1954	650	10	660	265	925	50.7	18	1,807	1,825	1,704
1955	605	9	614	284	898	46.5	17	1,915	1,932	1,793
1956	579	22	601	301	902	44.7	18	2,000	2,018	1,870

Source: Major Statistical Series of the United States Department of Agriculture, Volume 3 - Gross and Net Farm Income, Agriculture Handbook No. 118, Table 27.

Table 4--National income and income of the nonfarm population, by source, United States, 1910-56

Year	National income			Income of the nonfarm population		
	Originating in agriculture	From nonagricultural sources	Total	From agricultural sources	From nonagricultural sources	Total
	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars
1910	5,436	27,816	33,252	733	---	---
1911	4,656	27,737	32,393	768	---	---
1912	5,793	29,229	35,022	818	---	---
1913	5,100	32,452	37,552	847	---	---
1914	5,561	30,893	36,454	884	---	---
1915	5,752	32,822	38,574	955	---	---
1916	6,248	38,926	45,174	1,145	---	---
1917	10,534	44,215	54,749	1,533	---	---
1918	11,400	47,901	59,301	1,664	---	---
1919	11,904	55,704	67,608	1,843	---	---
1920	10,626	65,104	75,730	1,617	---	---
1921	5,449	53,823	59,272	1,311	---	---
1922	6,474	54,496	60,970	1,393	---	---
1923	7,388	64,238	71,626	1,493	---	---
1924	7,232	64,019	71,251	1,551	---	---
1925	9,047	67,257	76,304	1,472	---	---
1926	8,260	72,677	80,937	1,450	---	---
1927	8,094	71,029	79,123	1,525	---	---
1928	8,342	73,125	81,467	1,498	---	---
1929	8,510	78,612	87,122	1,486	---	---
1930	6,322	69,179	75,501	1,262	---	---
1931	4,949	55,097	60,046	968	---	---
1932	3,288	39,761	43,049	778	---	---
1933	3,820	36,752	40,572	808	---	---
1934	4,306	45,099	49,405	878	43,199	44,077
1935	6,821	50,231	57,052	963	48,231	49,194
1936	5,947	58,303	64,250	993	56,003	56,996
1937	7,757	64,184	71,941	1,003	61,684	62,687
1938	6,022	59,649	65,671	921	57,349	58,270
1939	6,161	64,175	70,336	972	61,675	62,647
1940	6,340	71,298	77,638	1,041	68,598	69,639
1941	8,753	86,653	95,406	1,298	83,553	84,851
1942	12,717	111,388	124,105	1,643	107,588	109,231
1943	15,139	138,811	153,950	1,891	134,611	136,502
1944	15,282	152,366	167,648	1,930	147,966	149,896
1945	15,995	152,595	168,590	1,974	148,395	150,369
1946	19,042	150,688	169,730	2,321	146,388	148,709
1947	19,899	165,397	185,296	2,516	160,497	163,013
1948	22,254	186,726	208,980	2,550	181,626	184,176
1949	17.066	187,575	204,641	2,415	182,375	184,790
1950	17,883	202,268	220,151	2,424	196,968	199,392
1951	20,617	230,162	250,779	2,614	224,562	227,176
1952	19,702	246,704	266,406	2,658	240,604	243,262
1953	17,615	260,278	277,893	2,521	254,278	256,799
1954	16,933	259,750	276,683	2,495	253,950	256,445
1955	16,065	280,314	296,379	2,475	274,014	276,489
1956	15,999	298,472	314,471	2,625	291,772	294,397

Source: Major Statistical Series of the United States Department of Agriculture, Volume 3 - Gross and Net Farm Income, Agriculture Handbook No. 118, Table 25.

Table 5—Realized gross income and net income of farm operators from farming, Louisiana, 1949-57

Classification	Year								
	1949	1950	1951	1952	1953	1954	1955	1956	1957
	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars	Million dollars
Realized gross farm income:									
Cash receipts from farm marketings	343.7	325.7	381.4	428.7	400.3	380.0	375.9	370.2	327.4
Government payments	9.1	11.4	11.6	9.5	6.7	11.3	10.3	13.1	21.6
Value of home consumption	55.1	49.6	56.5	53.8	47.2	41.7	42.7	40.9	
Gross rental value of farm dwellings	15.2	18.1	20.5	15.3	17.5	18.4	23.0	22.2	
Total	423.1	404.8	470.0	507.3	417.7	451.4	451.9	446.4	
Farm production expenses	190.7	205.0	230.2	246.2	245.1	243.9	246.0	255.7	
Realized net farm income	232.4	199.8	239.8	261.1	226.6	207.5	205.9	190.7	
Net change in inventory	-11.5	8.8	29.9	12.0	20.0	-9.0	9.8	-12.8	
Total net farm income	220.9	208.6	269.7	273.1	246.6	198.5	215.7	177.9	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Realized gross income per farm	3,181	3,067	3,615	3,995	3,804	3,700	3,766	3,782	3,568
Realized net income per farm	1,747	1,514	1,845	2,056	1,828	1,700	1,716	1,616	1,311
Total net income per farm	1,660	1,581	2,074	2,151	1,989	1,627	1,797	1,507	1,239

Source: Major Statistical Series of the United States Department of Agriculture, Volume 3 - Gross and Net Farm Income, Agriculture Handbook No. 118, Tables 21, 22, 23, and 24.

Table 6--Distribution of crop acreage by crop reporting districts--1954 Census

Crop	District 1	District 2	District 3	District 4	District 5	District 6	District 7	District 8	District 9	State total
	Per cent of total state acreage harvested									
Cotton	15.3	8.9	38.0	4.9	22.5	2.7	3.2	4.4	0.1	100.0
Rice	—	—	0.9	—	12.2	0.2	80.4	5.0	1.2	100.0
Sorghum, all	19.9	8.5	41.3	7.7	8.8	8.5	1.1	2.0	2.4	100.0
Irish potatoes	3.0	5.4	5.1	3.2	33.1	14.1	4.9	7.0	24.2	100.0
Sweet potatoes	0.8	1.3	1.3	0.6	54.8	6.9	12.9	21.0	0.4	100.0
Corn, all	6.6	9.1	21.3	4.0	25.7	12.6	3.2	11.8	5.5	100.0
Oats for grain	13.3	7.5	53.7	4.0	11.3	5.5	3.5	0.3	0.9	100.0
Sugar cane for sirup	1.3	3.7	0.9	2.1	29.3	13.3	2.8	36.5	10.0	100.0
Sugar cane for sugar	—	—	—	—	8.2	0.9	1.4	53.3	36.2	100.0
Sugar cane for seed	0.2	0.2	—	—	8.7	0.1	1.0	60.2	29.6	100.0
Soybeans, all	4.2	2.2	50.8	1.4	12.1	1.1	0.5	19.0	8.6	100.0
Soybeans for beans	2.5	1.7	77.7	1.7	15.8	0.1	0.1	0.4	—	100.0
Soybeans for hay	15.2	6.0	40.0	3.0	7.4	5.4	2.6	14.1	6.3	100.0
Soybeans for silage	3.1	8.4	55.5	2.3	23.1	3.2	1.3	1.2	1.9	100.0
Cowpeas, all	15.3	18.5	17.1	9.6	7.3	14.3	2.7	2.8	12.4	100.0
Cowpeas for dry peas	23.0	33.6	21.6	11.7	5.8	1.8	2.2	0.2	*	100.0
Cowpeas cut for hay	15.3	7.7	13.0	9.9	2.6	36.2	6.0	2.3	7.0	100.0
Cowpeas for silage	17.7	23.7	18.8	15.8	15.0	5.3	1.6	1.3	0.8	100.0
Blackeyes and other green cowpeas	9.5	36.0	6.5	4.7	4.3	26.5	2.0	0.7	9.8	100.0
Peanuts, all	26.0	36.0	1.7	15.6	7.4	5.3	7.5	*	0.5	100.0
Peanuts for picking	30.2	36.4	2.3	12.4	5.7	8.4	4.1	*	0.5	100.0
Peanuts saved for hay	21.3	40.4	1.0	17.2	8.6	1.0	10.5	—	*	100.0
Alfalfa, clover and their mixtures cut for hay	26.0	1.9	4.6	6.0	23.9	16.8	5.6	8.0	7.2	100.0
Lespedeza cut for hay	4.4	4.3	29.7	3.2	14.6	10.8	26.3	6.0	0.7	100.0
Hay cut, other	12.0	3.7	16.2	9.0	21.1	13.2	6.9	8.9	9.0	100.0

*Less than one-tenth of one per cent.

Source: Compiled from V.1-Pt. 24, United States Census of Agriculture, U.S. Department of Commerce, Bureau of the Census.

Table 7—Farms, farm property and farm population, 1910-55 Censuses

Items	Unit	1955	1950	1940	1930	1920	1910
Farms	Number	111,127	124,181	150,007	161,445	135,463	120,546
Land in Farms	Acres	11,441,343	11,202,278	9,996,108	9,355,437	10,019,822	10,439,481
Average Size of Farms	Acres	103.0	90.2	66.6	57.9	74.0	86.6
Total Cropland	Acres	5,647,502	5,657,467	6,038,067	5,656,234	5,626,226	5,276,016
Average Cropland per farm	Acres	49.2	45.6	40.3	35.0	41.5	43.8
Value of Farms (land and buildings)	Dollars	1,073,486,820	870,632,991	353,873,506	418,191,773	474,038,793	237,544,450
All Farm Operators	Number	111,240	124,181	150,007	161,445	135,463	120,546
Full Owners	Number	60,360	62,810	52,936	46,893	51,895	48,590
Part Owners	Number	12,828	11,584	7,376	6,266	5,359	4,399
Managers	Number	528	588	528	735	828	950
Tenants	Number	37,524	49,199	89,167	107,551	77,381	66,607
Total Population	Number	2,893,000	2,683,519	2,363,880	2,101,593	1,798,509	1,656,388
Farm Population	Number	507,744	567,455	853,949	830,606	786,050	--
Per Cent of Total	Per Cent	17.6	21.1	36.1	39.5	43.7	--

Table 8—Acres of land used in the production of selected crops, Louisiana, 1909–57

Year	Cotton	Sugar cane		Rice	Cowpeas for peas	Corn		Oats	Beans		Hay				
		Sugar	Sirup			All	Hybrid		Soybeans	Velvet	All	Alfalfa	Lespedeza	Legume	Misc.
	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
1909	931	313	17.7	370	—	1,592	—	30	—	—	179	—	—	—	—
1910	870	326	25.0	360	—	1,700	—	35	—	—	187	—	—	—	—
1911	938	336	32.5	350	—	1,700	—	36	—	—	182	—	—	—	—
1912	922	255	39.0	315	—	1,560	—	30	—	—	170	—	—	—	—
1913	1,117	284	38.0	350	—	1,600	—	36	—	—	176	—	—	—	—
1914	1,220	250	29.0	320	—	1,620	—	40	—	—	174	—	—	—	—
1915	916	238	30.0	385	—	1,660	—	60	—	—	204	—	—	—	—
1916	1,127	259	38.0	435	—	1,560	—	56	—	—	199	—	—	—	—
1917	1,252	285	45.8	485	—	1,600	—	52	—	—	201	—	—	—	—
1918	1,441	263	65.8	565	—	1,600	—	51	—	—	198	—	—	—	—
1919	1,304	233	22.0	543	—	1,523	—	50	—	—	203	8	—	85	—
1920	1,243	247	19.0	676	—	1,462	—	35	—	—	200	8	—	85	—
1921	1,009	272	19.0	549	—	1,580	—	27	—	—	210	12	—	94	—
1922	1,032	295	23.0	555	—	1,375	—	24	—	—	222	17	—	108	—
1923	1,255	286	29.0	474	—	1,278	—	25	—	—	235	20	—	119	—
1924	1,427	251	52.0	430	32	1,250	—	17	8	40	212	12	41	111	—
1925	1,727	236	25.0	414	33	1,225	—	14	12	41	195	10	29	103	—
1926	1,802	161	34.0	492	23	1,127	—	12	18	36	188	8	32	97	—
1927	1,448	89	15.0	520	30	1,161	—	11	21	35	206	9	24	120	—
1928	1,836	146	23.0	495	22	1,242	—	15	17	37	201	10	23	113	—
1929	1,934	198	20.0	465	25	1,190	—	15	21	38	203	12	24	109	58
1930	1,953	191	26.0	491	33	1,190	—	14	16	37	217	11	25	129	52
1931	1,825	186	21.0	458	43	1,368	—	31	12	41	236	17	29	125	65
1932	1,688	229	19.0	415	51	1,505	—	25	10	45	273	19	27	163	64
1933	1,295	219	24.0	395	54	1,429	—	22	7	49	277	17	30	156	74
1934	1,189	247	27.0	415	71	1,596	—	32	8	57	322	18	33	169	102

Continued

Table 8--(Continued)--Acres of land used in the production of selected crops, Louisiana, 1909-57

Year	Cotton	Sugar cane		Rice	Cow-peas for peas	Corn		Oats	Beans		Hay				
		Sugar	Sirup			All	Hybrid		Soy-beans	Vel-vet	All	Alfalfa	Lespe-deza	Legume	Misc.
	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
1935	1,268	261	25.0	412	62	1,628	--	57	9	58	300	19	37	166	76
1936	1,401	247	24.0	479	64	1,547	--	46	20	66	296	21	49	147	75
1937	1,569	285	26.0	517	64	1,485	--	52	12	68	288	23	45	149	64
1938	1,119	291	26.0	494	66	1,693	--	57	14	64	296	24	40	163	59
1939	1,120	255	29.0	485	58	1,647	4	60	16	78	313	29	56	155	63
1940	1,130	242	26.0	469	63	1,548	6	78	15	89	329	33	70	145	68
1941	1,014	255	24.0	545	65	1,440	16	86	16	97	350	32	80	145	79
1942	1,001	294	24.0	615	54	1,296	23	100	72	89	320	22	85	120	74
1943	982	276	29.0	603	44	1,270	27	132	33	90	344	21	88	110	104
1944	850	266	29.0	561	23	1,168	45	152	23	41	331	22	117	60	109
1945	750	253	45.0	584	18	1,075	53	131	23	25	326	20	116	54	120
1946	700	278	43.0	589	15	1,000	83	100	26	22	319	19	109	54	117
1947	770	286	36.0	613	19	960	148	100	23	18	300	16	104	64	123
1948	890	298	11.0	631	20	902	167	80	33	8	294	19	102	56	116
1949	950	301	11.0	593	17	758	196	60	23	4	307	25	91	57	122
1950	715	295	12.0	563	12	834	270	45	40	5	320	23	89	23	131
1951	935	279	9.0	619	8	709	254	43	48	3	323	22	98	23	134
1952	890	295	8.0	600	9	703	278	48	50	2	403	26	108	20	154
1953	950	299	5.0	612	9	605	257	75	50	1/	435	26	83	25	177
1954	688	266	8.0	679	8	647	304	110	73		398	27	60	1/	159
1955	615	248	7.0	526	9	647	311	124	88		441	27	48		230
1956	562	222	7.0	450	10	634	327	112	135		390	26	47		196
1957	440	243	4.0	400	6	628	382	95	119		416	23	54		210

Continued

Table 8—(Continued)—Acres of land used in the production of selected crops, Louisiana, 1909-57

Year	Peanuts	Irish potatoes	Sweet-potatoes	Tobacco, perique	Snapbeans		Cabbage, commercial	Water-melons, commercial	Beets	Cucumbers		Tomatoes	Onions	Garlic
					Spring	Fall				Spring	Fall			
	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
1909	5	20	57	—	—	—	—	—	—	—	—	—	—	—
1910	4	25	55	—	—	—	—	—	—	—	—	—	—	—
1911	5	22	57	—	—	—	—	—	—	—	—	—	—	—
1912	4	20	56	—	—	—	—	—	—	—	—	—	—	—
1913	4	21	60	—	—	—	—	—	—	—	—	—	—	—
1914	5	20	58	—	—	—	—	—	—	—	—	—	—	—
1915	6	22	62	—	—	—	—	—	—	—	—	—	—	—
1916	8	20	64	—	—	—	—	—	—	—	—	—	—	—
1917	9	23	62	—	—	—	—	—	—	—	—	—	—	—
1918	8	34	64	—	1.40	—	1.40	—	—	—	—	—	1.56	—
1919	6	20	68	0.8	1.50	—	1.54	—	—	—	—	—	0.97	—
1920	7	22	72	0.8	1.30	—	1.48	—	—	—	—	—	1.08	—
1921	8	23	73	0.9	2.00	—	1.58	—	—	—	—	—	1.01	—
1922	8	24	64	1.1	1.46	0.3	1.67	—	—	—	—	—	1.10	—
1923	8	23	54	0.9	1.54	0.7	2.00	—	—	0.25	—	—	1.20	—
1924	6	24	50	0.8	3.20	0.9	1.80	—	—	0.45	—	—	1.67	—
1925	5	29	60	0.8	5.00	3.2	2.50	—	—	0.50	—	1.02	2.32	—
1926	6	33	66	0.1	5.50	3.3	3.00	—	—	0.70	—	1.69	2.75	—
1927	9	36	83	0.1	6.20	3.6	3.20	—	3.00	0.65	—	1.68	2.90	—
1928	7	38	62	0.2	7.40	3.2	3.50	—	2.70	0.90	0.80	1.20	2.30	—
1929	8	29	67	0.3	8.00	4.0	3.10	—	2.50	0.66	0.78	1.10	2.20	—
1930	8	34	60	0.6	8.40	3.6	2.10	—	2.30	0.80	0.80	1.20	1.26	—
1931	10	48	83	0.6	8.00	2.6	5.40	—	2.20	0.40	0.85	1.30	1.10	—
1932	14	40	111	0.4	7.60	2.6	3.20	—	2.10	0.45	0.95	1.60	1.20	0.50
1933	12	38	98	0.3	4.50	3.7	2.20	—	2.10	0.45	0.90	2.10	0.50	0.50
1934	12	42	117	0.1	8.00	4.9	9.30	2.9	2.20	0.48	0.65	2.20	1.60	0.50

Continued

Table 8--(Continued)--Acres of land used in the production of selected crops, Louisiana, 1909-57

Year	Peanuts	Irish potatoes	Sweet-potatoes	Tobacco, perique	Snapbeans		Cabbage, commercial	Water-melons, commercial	Beets	Cucumbers		Tomatoes	Onions	Garlic
					Spring	Fall				Spring	Fall			
	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
1935	12	39	123	0.1	8.80	5.6	1.80	3.1	2.00	0.60	0.85	2.70	1.20	0.70
1936	11	39	111	0.1	8.80	6.2	3.60	4.9	1.50	0.50	0.75	2.80	1.10	0.50
1937	10	44	97	0.4	9.20	4.4	4.20	4.8	1.50	0.55	0.80	2.80	1.70	0.60
1938	11	43	109	0.6	10.90	3.7	3.80	4.6	1.10	0.50	0.90	3.10	1.70	0.75
1939	11	40	95	1.0	9.20	4.0	4.60	8.0	1.10	0.50	1.20	2.60	1.70	0.75
1940	11	40	86	0.5	7.30	4.4	4.60	7.2	1.00	0.55	0.90	2.90	1.10	0.70
1941	8	43	90	0.2	6.60	3.0	4.60	6.8	0.90	0.60	0.90	3.00	1.70	0.65
1942	24	42	88	0.2	7.40	2.4	5.70	5.4	0.80	0.60	0.75	2.90	1.25	0.70
1943	20	57	124	0.3	8.00	2.1	5.10	4.8	0.70	0.48	1.00	2.80	1.55	0.48
1944	5	59	100	0.4	6.00	2.2	8.30	6.7	0.70	1.00	1.50	2.50	1.80	0.38
1945	5	38	116	0.3	6.00	3.0	7.50	6.4	0.50	0.85	1.20	2.20	2.00	0.31
1946	4	33	125	0.3	7.20	2.9	7.40	7.4	0.50	1.00	1.40	1.80	2.00	0.25
1947	5	24	94	0.6	5.40	2.4	8.00	6.2	0.35	0.80	0.90	1.50	1.10	0.18
1948	3	17	86	0.3	4.50	2.0	5.00	5.2	0.25	0.75	0.90	1.30	0.45	0.13
1949	3	14	92	0.3	3.70	2.0	5.30	4.7	0.30	0.65	1.10	1.40	0.50	0.10
1950	3	14	107	0.4	4.40	2.2	5.60	4.5	0.20	0.60	1.20	1.20	0.45	0.09
1951	3	12	72	0.4	4.20	1.8	1.80	3.9	0.12	0.60	0.90	1.10	0.40	0.06
1952	2	10.6	86	0.35	4.00	1.7	3.00	3.5	0.10	0.60	0.90	1.10	0.35	0.05
1953	1/	10.9	94	0.32	3.80	1.6	5.20	2.8	0.10	0.45	1.00	1.00	1/	1/
1954		11.3	93	0.30	4.00	1.2	3.70	2.1	1/	0.60	0.60	1.50		
1955		9.6	101	0.20	3.20	1.0	3.90	4.3		0.80	0.50	1.20		
1956		8.3	84	0.28	2.50	1.4	3.50	3.9		0.60	0.60	1.00		
1957		8.6	82	0.24	2.70	1.2	3.30	4.2		0.60	0.70	1.00		

Continued

Table 8--(Continued)--Acres of land used in the production of selected crops, Louisiana, 1909-57

Year	Shallots		Egg plant	Green peppers, Fall	Carrots	Spinach	Vegetable crops for processing	Straw-berries	White clover seed	Lespedeza seed	Total in selected crops	Total acres harvested 2/
	Spring	Winter										
	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
1909	--	--	--	--	--	--	--	--	--	--	3,514.70	3,585.62
1910	--	--	--	--	--	--	--	--	--	--	3,587.00	
1911	--	--	--	--	--	--	--	--	--	--	3,658.50	
1912	--	--	--	--	--	--	--	--	--	--	3,371.00	
1913	--	--	--	--	--	--	--	--	--	--	3,383.00	
1914	--	--	--	--	--	--	--	--	--	--	3,736.00	
1915	--	--	--	--	--	--	--	--	--	--	3,583.00	
1916	--	--	--	--	--	--	--	--	--	--	3,766.00	
1917	--	--	--	--	--	--	--	--	--	--	4,014.80	
1918	--	--	--	--	--	--	--	4.90	--	--	4,299.06	
1919	--	--	--	--	--	--	--	3.90	--	--	3,980.71	3,924.27
1920	--	--	--	--	--	--	--	6.50	--	--	3,994.16	
1921	--	--	--	--	--	--	--	8.25	--	--	3,783.74	
1922	--	--	--	--	--	--	--	11.56	--	--	3,639.19	
1923	--	--	--	--	1.22	--	--	14.35	--	--	3,689.16	
1924	--	--	--	0.85	1.27	--	--	14.60	--	12.0	3,836.54	3,484.75
1925	--	--	0.40	1.70	2.36	1.90	--	10.34	--	14.0	4,062.04	
1926	--	--	0.54	2.00	3.75	1.70	--	18.50	--	12.0	4,053.53	
1927	--	--	0.45	1.60	4.75	1.65	--	21.10	--	5.4	3,720.28	
1928	--	--	0.68	2.10	2.50	2.10	3.64	23.20	--	5.0	4,202.42	
1929	--	--	0.65	1.30	2.30	2.00	2.24	24.00	--	4.5	4,272.63	4,068.16
1930	--	--	0.60	1.15	2.30	1.99	5.84	22.00	--	4.8	4,329.74	
1931	--	--	0.50	1.10	2.20	1.50	2.62	20.50	--	4.2	4,417.07	
1932	--	--	0.50	0.90	2.20	1.20	1.63	23.00	--	3.7	4,478.73	
1933	--	--	0.50	1.05	2.10	1.20	1.11	18.80	--	3.5	3,964.51	
1934	--	--	0.55	1.05	2.10	1.50	1.68	19.40	--	3.4	4,197.51	3,977.02

Continued

Table 8--(Continued)--Acres of land used in the production of selected crops, Louisiana, 1909-57

Year	Shallots		Egg plant	Green peppers, Fall	Carrots	Spinach	Vegetable crops for processing	Straw-berries	White clover seed	Lespe-deza seed	Total in selected crops	Total acres harvested2/
	Spring	Winter										
	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres	Thou-sand Acres
1935	--	--	0.65	1.25	1.90	1.20	2.23	18.30	—	2.9	4,310.38	
1936	—	--	0.55	1.30	1.90	1.10	2.68	14.80	10.0	3.7	4,417.78	
1937	2.8	3.2	0.50	1.20	1.90	1.10	3.68	17.60	8.6	3.0	4,591.53	
1938	2.7	3.0	0.75	1.60	2.20	1.20	3.30	22.00	6.7	2.5	4,360.60	
1939	2.4	3.0	0.70	1.40	2.20	1.40	2.10	23.10	6.2	5.4	4,293.50	4,051.67
1940	2.0	2.7	0.60	1.20	2.00	1.40	4.15	20.70	8.1	7.1	4,213.10	
1941	1.9	2.2	0.55	1.30	2.00	1.20	4.65	22.60	9.5	9.0	4,132.85	
1942	2.4	2.8	0.50	1.20	1.80	1.20	5.60	20.50	11.4	11.0	4,128.50	
1943	2.3	2.7	0.50	1.60	1.70	1.00	5.80	13.90	11.8	7.0	4,106.61	
1944	2.1	1.9	0.45	1.80	1.50	1.00	4.30	9.50	11.8	12.0	3,730.83	3,490.16
1945	2.2	2.7	0.40	2.00	1.50	0.90	3.45	10.50	8.6	11.9	3,514.51	
1946	2.2	3.2	0.40	2.50	0.90	0.90	3.62	15.40	8.0	12.1	3,414.27	
1947	2.0	2.7	0.35	2.50	0.80	0.80	3.19	17.80	12.0	5.0	3,468.57	
1948	1.9	2.9	0.33	2.70	0.75	0.65	1.83	14.40	11.0	7.1	3,500.74	
1949	1.6	2.9	0.30	3.00	0.70	0.60	1.78	13.40	7.0	4.5	3,380.83	3,148.88
1950	1.9	2.6	0.30	2.70	0.65	0.50	2.00	13.30	5.1	2.6	3,244.19	
1951	2.0	3.0	0.30	2.90	0.55	0.40	1.25	13.40	17.5	1.8	3,335.38	
1952	2.5	3.5	0.30	2.80	0.55	0.30	1.10	5.80	22.0	1/	3,299.35	
1953	1.9	3.5	1/	2.40	1/	1/	1.41	9.00	9.5		3,236.70	
1954	1.9	2.8		3.40			1.86	10.80	10.0		3,576.06	3,010.58
1955	2.2	4.6		2.30			2.20	8.80	11.0		3,477.10	
1956	2.6	2.9		1.90			2.60	8.40	11.5		3,253.88	
1957	2.0	2.9		2.10			1.36	8.50	10.0		3,142.40	

1/Series discontinued.

2/United States Census Reports.

Table 9--Louisiana's rank in volume of production among the states in crops and livestock, 1950-57

Commodity	Rank							
	1950	1951	1952	1953	1954	1955	1956	1957
Crops								
Cotton lint	9	9	7	7	8	9	7	9
Cottonseed	8	9	7	7	8	10	7	9
Rice	2	2	2	2	2	2	2	3
Sugar cane for sugar and seed	1	1	1	1	1	1	1	1
Sugar cane for sirup	1	1	1	1	1	1	1	1
Sweetpotatoes	1	1	1	1	1	1	1	1
Irish potatoes								
All	42	42	42	37	39	44	42	40
Late spring states	9	10	10	9	9	10	9	10
Corn	27	28	27	27	24	26	27	28
Oats	39	39	36	34	31	30	32	33
Soybeans for beans	21	22	23	22	19	20	21	21
Hay, all	43	45	44	43	44	39	42	39
Tung nuts	3	3	3	3	3	1/	2	3
Cowpeas for peas	10	10	8	7	9	8	6	9
Velvet beans	6	6	6	6	2/			
Peanuts picked and threshed	13	13	13	13	2/			
Tobacco	21	20	20	19	19	19	18	18
Lespedeza seed	16	16	2/					
Livestock (volume)								
Cattle and calves	30	31	24	24	22	21	22	21
Hogs	26	26	27	27	27	27	25	27
Sheep and lambs	36	35	33	33	34	33	38	38
Chickens	29	32	31	31	34	36	36	36
Broilers	31	32	26	23	22	23	21	19
Turkeys	45	45	45	42	42	43	44	44

1/Crop failure due to a late winter freeze.

2/Series discontinued.

Table 10--Rank in cash receipts of crops, livestock and livestock products in Louisiana, 1950-57

Commodity	Rank							
	1950	1951	1952	1953	1954	1955	1956	1957
Livestock and Livestock Products								
Cattle and calves	4	3	3	3	3	3	3	1
Hogs	6	6	8	7	6	9	8	6
Sheep and lambs	27	28	27	27	26	24	26	26
Dairy products	5	4	5	5	5	5	5	4
Wool	25	23	25	28	25	26	28	27
Chickens (and broilers)	12	14	12	16	10	6	9	7
Turkeys	24	21	22	23	22	25	25	28
Eggs	8	9	9	9	9	7	7	9
Crops								
Cotton lint	1	1	1	1	1	1	1	2
Cottonseed	7	7	7	6	7	8	6	10
Sugar cane for sugar	3	5	4	4	4	4	4	5
Sugar cane for sirup	14	16	14	15	16	18	18	19
Rice	2	2	2	2	2	2	2	3
Corn	17	17	19	20	18	13	13	15
Oats	26	25	24	22	20 & 21	20	22	23
Hay	19	19	20	19	19	19	19	18
Irish potatoes	20	20	21	21	20 & 21	21	20	22
Sweetpotatoes	9	8	6	8	8	10	10	8
Soybeans	18	18	17	18	17	14	15	12
Commercial vegetables	11	11	10	11	12	16	14	13
Fruit and Tree Nuts								
Strawberries	10	10	11	10	11	15	12	14
Peaches	28	27	28	24	28	1/	27	25
Oranges	21	26	26	26	23	22	24	21
Pecans	15	13	15	13	14	11	17	17
Tung nuts	22	24	18	17	24	27	21	20
Watermelons	23	22	23	25	27	23	23	24
Other Products								
Forest	13	12	13	12	13	12	11	11
Greenhouse, nursery	16	15	16	14	15	17	16	16

1/Crop failure in Louisiana.

Table 11—Cash receipts from farm marketings, value of products consumed in farm household, and government payments, 1924-57

Year	Crops		Livestock and livestock products		Cash receipts from farm marketings	Value of home consumption	Government payments	Cash receipts from farm marketings and Government payments	Cash receipts from farm marketings, value of home consumption, and Government payments
	Cash receipts from farm marketings	Value of home consumption	Cash receipts from farm marketings	Value of home consumption					
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1924	99,974	10,738	21,510	19,830	121,484	30,568	---	121,484	152,052
1925	135,522	13,780	23,204	19,608	158,726	33,388	---	158,726	192,114
1926	109,433	13,708	25,174	21,240	134,607	34,948	---	134,607	169,555
1927	99,646	13,521	26,280	21,285	125,926	34,806	---	125,926	160,732
1928	110,475	12,348	25,816	20,809	136,291	33,157	---	136,291	169,448
1929	134,771	13,455	27,026	20,170	161,797	33,625	---	161,797	195,422
1930	83,845	12,002	24,393	19,397	108,238	31,399	---	108,238	139,637
1931	65,135	11,241	17,683	17,000	82,818	28,241	---	82,818	111,059
1932	47,375	9,653	13,913	13,508	61,288	23,161	---	61,288	84,449
1933	51,271	9,502	13,484	12,896	64,755	22,398	4,970	69,725	92,123
1934	72,872	10,459	15,451	15,162	88,323	25,621	7,563	95,886	121,507
1935	85,846	11,686	20,344	17,720	106,190	29,406	20,358	126,548	155,954
1936	108,179	11,653	20,864	19,066	129,043	30,719	5,383	134,426	165,145
1937	97,519	11,365	23,804	19,144	121,323	30,509	7,178	128,501	159,010
1938	82,541	11,789	24,680	18,203	107,221	29,992	17,596	124,817	154,809
1939	84,610	12,441	24,955	17,808	109,565	30,249	21,184	130,749	160,998
1940	66,764	10,601	26,346	16,587	93,110	27,188	21,902	115,012	142,200
1941	84,480	11,322	32,907	19,045	117,387	30,367	16,799	134,186	164,553
1942	139,963	12,533	44,573	23,006	184,536	35,539	9,756	194,292	229,831
1943	183,827	16,285	57,646	29,276	241,473	45,561	17,400	258,873	304,434
1944	174,420	16,085	63,185	27,881	237,605	43,966	17,020	254,625	298,591

Continued

Table 11--(Continued)--Cash receipts from farm marketings, value of products consumed in farm household, and government payments, 1924-57

Year	Crops		Livestock and livestock products		Cash receipts from farm marketings	Value of home consumption	Government payments	Cash receipts from farm marketings and Government payments	Cash receipts from farm marketings, value of home consumption, and Government payments
	Cash receipts from farm marketings	Value of home consumption	Cash receipts from farm marketings	Value of home consumption					
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1945	186,582	19,995	71,644	29,845	258,226	49,840	12,796	271,022	320,862
1946	172,732	21,652	82,725	36,447	255,457	58,099	11,795	267,252	325,351
1947	227,544	26,850	107,853	40,080	335,397	66,930	9,079	344,476	411,406
1948	246,827	21,734	107,675	42,352	354,502	64,086	8,558	363,060	427,146
1949	235,320	18,821	100,482	36,763	335,802	55,584	9,093	344,895	400,479
1950	226,952	16,117	96,552	31,425	323,504	47,542	11,437	334,941	382,483
1951	263,834	17,843	118,526	34,714	382,360	52,557	11,584	393,944	446,501
1952	318,808	16,260	117,357	33,421	436,165	49,681	9,543	445,608	495,389
1953	289,624	16,966	112,763	32,689	402,387	49,655	6,720	409,107	465,165
1954	262,119	17,739	114,039	25,963	376,158	45,745	11,306	387,464	418,811
1955	244,062	17,105	115,442	24,285	359,504	41,400	10,325	369,829	413,360
1956	253,016	17,576	117,392	23,336	370,152	40,900	13,118	385,042	426,942
1957	208,749		138,988		327,350		21,552		

Table 12--Cash receipts from farm marketings, by commodities, 1939-57

Commodity	Average 1939-43	Average 1944-48	1949	1950	1951	1952	1953	1954	1955	1956	1957
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
Livestock and livestock products	36,375.6	86,955.0	98,221	95,904	117,258	115,659	111,268	115,453	113,301	115,492	137,670
Cattle & calves	11,277.4	36,139.0	38,673	37,855	51,903	43,932	42,766	48,286	51,240	48,898	65,218
Hogs	8,181.2	18,865.6	19,534	18,229	17,861	17,542	12,686	13,604	8,650	9,966	13,297
Sheep & lambs	200.6	314.2	261	116	118	157	251	192	310	267	248
Dairy products	9,871.6	18,025.6	23,425	26,370	29,490	33,454	34,031	33,027	33,658	35,952	37,861
Wool	248.2	258.8	143	155	293	170	219	223	198	170	204
Chickens (and broilers)	2,539.0	5,092.6	5,683	4,841	6,637	10,026	10,087	9,206	9,583	9,960	10,926
Turkeys	165.6	236.8	318	432	567	662	620	468	244	283	139
Eggs	3,892.0	8,022.4	10,184	7,906	10,389	9,716	10,608	10,447	9,418	9,996	9,777
Crops	104,318.0	175,446.8	198,878	210,862	262,989	306,824	266,832	236,536	237,190	227,230	178,782
Cotton lint	40,236.8	62,225.2	94,507	84,774	140,903	138,172	130,638	107,630	94,517	95,143	56,295
Cottonseed	7,414.2	10,921.0	10,104	11,116	16,346	17,876	15,181	12,306	9,389	11,318	6,216
Sugar cane, sugar	16,671.2	28,450.4	30,963	41,859	26,198	37,771	40,074	38,530	36,015	37,292	34,443
Sugar cane, sirup	2,974.6	6,713.4	1,539	2,938	2,233	2,876	1,860	2,081	2,572	1,826	1,432
Rice	24,689.4	44,481.0	43,110	53,463	52,753	78,928	56,528	55,500	72,544	57,867	54,946
Corn	1,143.8	1,563.2	1,290	1,571	1,670	1,587	1,154	1,083	4,403	4,185	3,932
Oats	273.8	617.2	284	153	183	281	750	774	892	565	533
Hay	550.2	990.2	900	1,147	969	1,261	1,164	922	1,333	1,315	1,542
Irish potatoes	2,126.4	2,497.6	1,444	685	641	1,161	750	774	606	963	538
Sweetpotatoes	4,058.4	9,553.6	9,190	6,710	15,024	18,274	12,097	10,486	7,360	8,565	9,932
Soybeans	427.6	759.6	711	1,448	1,635	2,301	1,465	1,952	4,177	4,086	4,564
Commercial vegetables	3,751.6	6,674.4	4,836	4,998	4,434	6,336	5,171	4,498	3,382	4,105	4,409
Fruits and tree nuts	6,634.6	13,014.4	12,162	10,350	8,454	9,188	13,381	8,948	12,082	10,825	9,458
Strawberries	4,437.2	8,179.4	6,399	6,380	4,574	4,098	7,150	5,148	4,053	6,515	4,240
Peaches	204.0	383.6	134	88	119	125	369	168	1/	211	358
Oranges	434.4	695.4	779	613	171	158	310	465	464	404	637
Pecans	978.6	2,043.0	2,740	2,162	2,832	2,519	3,619	2,523	7,097	2,409	2,652
Tung nuts	182.0	984.8	1,613	573	281	1,916	1,593	464	57	821	1,067
Watermelons	398.4	728.2	497	534	477	372	340	180	411	465	504
Other products	2,233.2	2,909.2	2,667	5,143	5,443	5,715	5,592	5,508	8,953	11,008	9,104
Forest	1,725.2	2,278.6	1,935	3,069	3,096	3,270	3,113	3,037	5,622	7,523	5,459
Greenhouse, nursery	508.0	630.6	732	2,074	2,347	2,445	2,479	2,471	3,331	3,485	3,645
Total from selected commodities	149,561.4	278,325.4	311,928	322,259	394,144	437,386	397,073	366,445	371,526	364,555	335,014

Year	On hand Jan. 1		Calves born		In shipments	Marketings1/		Farm slaughter		Deaths	
	All cattle	All cows 2 yrs. and over	Number	Per cent of cows 2 yrs. and over		Cattle	Calves	Cattle	Calves	Cattle	Calves
	1,000	1,000	1,000	Per cent	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1924	884	490	265	54	11	139	56	24	14	28	28
1925	871	493	261	53	8	144	66	15	19	30	30
1926	836	485	269	55	15	130	81	18	12	30	30
1927	819	480	302	63	20	177	86	11	11	24	22
1928	810	473	292	62	30	134	109	15	5	28	22
1929	819	480	297	62	17	136	92	16	4	28	21
1930	836	437	295	61	20	147	65	12	8	28	22
1931	869	495	303	61	16	139	57	12	10	25	25
1932	920	520	319	61	15	141	48	15	15	23	26
1933	986	548	337	61	12	144	41	15	15	24	26
1934 2/	1,070	582	373	64	10	174	58	30	7	24	35
1935 2/	1,125	602	379	63	9	270	72	12	15	34	30
1936	1,080	607	407	67	12	215	80	12	15	33	42
1937	1,102	608	413	68	13	221	95	10	13	29	35
1938	1,125	629	421	67	18	255	85	7	11	25	33
1939	1,148	615	430	70	19	213	102	10	12	26	30
1940	1,204	656	446	68	18	234	115	7	11	43	42
1941	1,216	663	451	68	15	216	131	7	10	34	44
1942	1,240	709	518	73	13	158	180	6	9	32	35
1943	1,351	761	548	72	24	156	176	6	9	35	41
1944	1,500	825	578	70	22	211	214	8	13	40	53
1945	1,561	894	599	67	45	337	210	7	13	39	54
1946	1,545	896	627	70	50	384	263	9	14	41	59
1947	1,452	857	583	68	33	415	302	7	13	38	44
1948	1,249	775	558	72	24	252	272	6	13	30	34
1949	1,224	745	581	78	23	185	281	5	13	22	37
1950	1,285	783	626	80	22	120	299	6	13	31	38
1951	1,426	855	650	76	16	137	318	5	13	37	42
1952	1,540	930	744	80	27	106	333	5	13	33	45
1953	1,833	1,062	839	79	17	256	433	5	16	31	44
1954	1,943	1,163	872	75	20	353	472	6	15	39	46
1955	1,904	1,164	966	83	21	302	555	7	15	39	50
1956	1,923	1,213	946	78	15	300	516	7	16	34	50
1957	1,961	1,210	944	78	14	393	535	7	14	37	50
1958	1,883	1,198									

1/Excludes interfarm sales. 2/Includes government purchases.

Table 14 --Cattle and calves: Production, marketings, price, and income, 1924-57

Year	Production	Marketings 1/	Average price per 100 pounds		Cash receipts	Value of home consumption	Gross income	Cost of inshipments
			Cattle	Calves				
	1,000 Pounds	1,000 Pounds	Dollars	Dollars	1,000 Dollars	1,000 Dollars	1,000 Dollars	1,000 Dollars
1924	98,100	91,240	4.65	5.50	4,786	289	5,075	167
1925	94,145	95,640	4.70	6.00	4,997	231	5,228	134
1926	88,740	89,340	4.70	6.50	4,789	234	5,023	270
1927	116,280	118,240	5.70	7.20	7,233	189	7,422	432
1928	96,960	95,660	7.30	9.50	7,753	262	8,015	828
1929	101,745	94,480	7.30	9.70	7,657	272	7,929	405
1930	112,805	97,300	5.80	8.20	6,186	196	6,382	378
1931	115,995	91,380	4.70	6.00	4,671	164	4,835	174
1932	123,445	91,320	3.65	4.30	3,649	164	3,813	131
1933	132,765	92,140	3.15	4.15	3,203	147	3,350	84
1934 2/	131,585	109,000	3.45	4.10	4,127	237	4,364	70
1935 2/	156,240	169,200	4.20	5.30	7,359	167	7,526	132
1936	154,215	140,725	4.50	5.40	6,729	176	6,905	168
1937	160,440	145,900	5.00	6.10	7,717	166	7,883	237
1938	172,435	168,725	4.65	5.90	8,206	119	8,325	353
1939	172,080	145,230	5.20	6.60	8,048	170	8,218	459
1940	168,445	162,625	5.50	6.80	9,438	142	9,580	469
1941	173,980	159,140	6.80	8.60	11,581	174	11,755	450
1942	177,830	135,250	8.40	10.60	12,525	201	12,726	493
1943	189,695	134,080	10.20	12.00	14,795	236	15,031	989
1944	197,555	165,270	9.20	11.20	16,685	299	16,984	1,044
1945	224,280	252,040	10.30	12.20	27,426	314	27,740	2,409
1946	249,270	304,295	12.00	14.80	39,001	433	39,434	3,282
1947	236,280	325,960	14.50	18.40	50,911	457	51,368	2,888
1948	202,135	229,480	18.60	22.90	46,672	573	47,245	2,727
1949	217,510	196,720	17.70	21.40	38,673	506	39,729	2,208
1950	218,620	165,260	19.70	24.50	37,855	658	38,513	2,614
1951	241,915	192,490	23.60	29.10	51,903	691	52,594	2,408
1952	273,805	192,180	20.30	23.60	43,932	610	44,542	3,261
1953	361,570	325,045	11.00	15.20	42,766	430	43,196	1,366
1954	427,945	399,545	10.00	15.20	48,476	760	49,236	1,542
1955	458,595	399,885	10.20	15.60	51,240	904	52,144	1,523
1956	409,995	395,460	10.10	14.80	48,898	949	49.847	1,055
1957	439,405	473,795	11.50	16.90	65,218	992	66,210	1,263

1/Excludes interfarm sales. 2/Includes government purchases.

Table 15--Cattle slaughter: Number of head, by months, January 1946-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	1,000 head												
1946	17.0	17.0	17.0	16.0	14.0	13.0	20.0	14.0	11.0	17.0	22.0	18.0	196.0
1947	20.0	15.0	14.0	16.0	17.0	18.0	18.0	17.0	20.0	21.0	21.0	19.0	216.0
1948	18.0	13.2	16.0	18.0	15.0	16.0	14.5	15.0	16.0	16.0	15.0	13.8	186.5
1949	13.0	12.3	13.3	11.9	13.6	13.6	13.2	14.2	14.2	13.6	14.3	13.2	160.4
1950	13.3	11.1	11.3	10.7	11.8	12.3	12.9	14.2	13.0	12.3	13.1	11.7	147.7
1951	13.2	10.4	9.8	7.6	7.0	7.6	8.6	10.1	8.8	10.5	10.3	7.4	111.3
1952	7.8	6.9	6.9	6.7	8.1	7.8	8.1	7.1	8.8	9.2	7.6	7.8	92.8
1953	9.3	7.5	8.5	10.2	10.9	11.9	13.4	12.1	15.0	17.0	15.0	15.3	146.1
1954	15.2	11.5	14.1	13.8	15.0	17.0	18.0	18.0	19.0	19.0	20.0	18.0	198.6
1955	18.0	14.9	18.0	18.0	20.0	22.0	20.0	22.0	20.0	19.0	20.0	16.0	227.9
1956	18.0	13.8	13.7	16.0	18.0	21.0	21.0	22.0	20.0	22.0	22.0	18.0	225.5
1957	19.0	16.0	17.0	18.0	21.0	22.0	23.0	22.0	20.0	22.0	19.0	18.0	237.0
1958	19.0	15.0	13.3	17.6	18.4	20.3	21.3	17.9					

---

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 16--Calf slaughter: Number of head, by months, January 1946-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	1,000 head												
1946	30.0	20.0	22.0	20.0	19.0	23.0	45.0	52.0	39.0	50.0	43.0	38.0	401.0
1947	29.0	20.0	19.0	20.0	23.0	27.0	34.0	35.0	38.0	40.0	35.0	33.0	353.0
1948	26.0	19.0	21.0	21.0	22.0	23.0	24.0	26.0	29.0	29.0	30.0	27.0	297.0
1949	21.0	14.5	16.0	17.0	18.0	22.0	22.0	26.0	26.0	27.0	30.0	26.0	265.5
1950	22.0	16.0	17.0	16.0	20.0	22.0	22.0	22.0	24.0	24.0	26.0	21.0	252.0
1951	17.0	11.3	12.8	12.2	15.0	17.0	20.0	25.0	20.0	25.0	22.0	17.0	214.3
1952	18.0	14.9	14.1	13.8	18.0	19.0	23.0	25.0	28.0	31.0	27.0	25.0	256.8
1953	23.0	19.0	20.0	22.0	22.0	28.0	31.0	31.0	36.0	35.0	33.0	28.0	328.0
1954	27.0	22.0	23.0	22.0	25.0	30.0	32.0	35.0	37.0	35.0	33.0	38.0	349.0
1955	26.0	21.0	23.0	23.0	27.0	30.0	29.0	30.0	33.0	34.0	30.0	26.0	332.0
1956	26.0	20.0	23.0	25.0	30.0	29.0	32.0	36.0	34.0	39.0	34.0	27.0	355.0
1957	32.0	25.0	26.0	26.0	30.0	30.0	37.0	36.0	32.0	34.0	29.0	26.0	363.0
1958	25.0	18.6	19.5	20.2	25.5	23.3	25.0	23.8					

---

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 17--Cattle slaughter: Average live weight per head, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	Pounds												
1947	727	730	648	665	680	663	681	657	634	679	664	654	672
1948	657	663	708	736	727	651	702	690	722	701	699	706	698
1949	712	694	688	708	693	697	705	690	683	711	705	740	702
1950	714	735	743	693	719	717	732	718	730	712	717	697	719
1951	732	734	788	732	746	734	738	746	733	749	741	770	745
1952	760	798	761	723	735	766	748	725	721	732	739	717	744
1953	669	701	695	709	703	697	718	703	700	723	724	686	705
1954	682	701	714	697	700	708	716	721	716	711	705	728	713
1955	718	692	680	698	709	734	692	717	722	722	757	741	718
1956	750	723	728	721	716	718	724	731	725	729	711	713	723
1957	721	746	717	737	739	740	727	747	736	755	733	739	734
1958	745	721	743	722	776	762	741	729					

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages are based on unrounded numbers.

Table 18--Calf slaughter: Average live weight per head, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	Pounds												
1947	367	381	387	388	381	367	345	329	334	334	340	325	351
1948	373	356	375	370	366	350	353	351	346	344	347	355	357
1949	381	400	408	400	391	374	357	362	348	353	365	368	372
1950	383	391	398	402	386	375	377	374	365	356	360	356	374
1951	394	380	414	367	340	326	336	336	341	342	348	345	350
1952	375	386	369	373	375	363	357	355	350	383	375	363	370
1953	386	418	416	419	377	373	357	363	344	347	346	346	370
1954	368	381	403	372	367	354	345	344	351	342	348	359	357
1955	378	376	415	398	373	362	367	365	353	359	349	362	369
1956	380	397	421	408	405	376	379	371	357	360	372	382	379
1957	393	391	408	407	381	384	357	374	373	372	379	372	382
1958	382	393	387	408	390	386	391	384					

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages are based on unrounded numbers.

Table 19--Cattle slaughter: Total live weight, by months, January 1947-August 1958[1/]

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
	1,000 pounds												
1947	14,782	10,596	8,890	10,342	11,666	11,742	12,460	10,907	12,944	14,210	14,179	12,430	145,148
1948	11,697	8,775	10,959	13,014	10,955	10,658	10,195	10,393	11,933	11,078	10,703	9,732	130,092
1949	9,271	8,528	9,139	8,405	9,441	9,458	9,306	9,769	9,694	9,678	10,102	9,774	112,565
1950	9,492	8,137	8,398	7,452	8,447	8,805	9,456	10,225	9,458	8,720	9,377	8,178	106,145
1951	9,677	7,620	7,730	5,582	5,203	5,551	6,352	7,541	6,464	7,872	7,631	5,685	82,908
1952	5,973	5,536	5,285	4,834	5,972	5,959	6,035	5,151	6,347	6,730	5,627	5,600	69,049
1953	6,193	5,250	5,899	7,225	7,669	8,295	9,602	8,495	10,824	12,162	10,853	10,496	102,963
1954	10,371	8,074	10,096	9,616	10,556	12,297	13,216	13,106	13,313	13,221	14,337	13,333	141,536
1955	12,964	10,327	12,150	12,204	14,636	16,133	13,842	15,925	14,654	13,949	14,718	12,064	163,566
1956	13,211	10,015	9,996	11,403	13,050	15,171	15,038	16,256	14,415	15,889	15,687	12,951	163,082
1957	13,765	11,729	12,050	13,198	15,305	16,099	17,061	16,187	14,966	16,609	13,927	13,133	174,029
1958	14,011	10,815	9,882	12,707	14,278	15,469	15,783	13,049					

Table 20--Calf slaughter: Total live weight, by months, January 1947-August 1958[1/]

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
	1,000 pounds												
1947	10,733	7,703	7,296	7,578	8,937	9,817	11,787	11,700	12,717	13,212	11,864	10,673	124,017
1948	9,627	6,896	7,693	7,626	8,106	8,191	8,555	9,263	9,989	10,133	10,559	9,439	106,077
1949	7,969	5,814	6,500	6,605	7,334	8,211	7,814	9,302	9,196	9,440	11,056	9,626	98,867
1950	8,246	6,445	6,901	6,409	7,597	8,184	8,319	8,249	8,629	8,375	9,457	7,369	94,180
1951	6,660	4,290	5,296	4,461	5,174	5,494	6,539	8,306	6,964	8,466	7,592	5,800	75,042
1952	6,921	5,763	5,207	5,145	6,818	6,947	8,310	9,812	9,731	12,042	10,079	9,160	94,935
1953	8,747	8,035	8,220	9,253	8,463	10,495	11,143	11,266	12,372	12,217	11,324	9,695	121,230
1954	10,006	8,207	9,417	8,111	9,029	10,461	10,904	12,057	12,996	12,036	11,444	9,863	124,531
1955	10,043	7,985	9,409	9,170	10,189	10,774	10,494	11,164	11,492	12,130	10,524	9,236	122,610
1956	9,727	7,829	9,636	10,123	12,114	10,914	11,993	13,441	12,230	13,954	12,528	10,166	134,655
1957	12,606	9,909	10,490	10,438	11,561	11,711	13,141	13,509	12,097	12,599	10,868	9,622	138,551
1958	9,451	7,310	7,546	8,242	9,945	8,994	9,775	9,139					

[1/] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages are based on unrounded numbers.

Table 21--Cattle: Number on farms, value per head, and farm value, January 1, 1909-58

Year	Number			Value per head			Farm value		
	Dairy[1]	Other	All	Dairy	Other	All	Dairy	Other	All
	1,000	1,000	1,000	Dollars	Dollars	Dollars	1,000 dollars	1,000 dollars	1,000 dollars
1909	222	558	780	23.50	10.00	13.80	5,217	5,580	10,797
1910	237	511	748	24.30	10.30	14.70	5,759	5,263	11,022
1911	240	515	755	29.50	11.60	17.30	7,080	5,974	13,054
1912	250	515	765	29.50	11.20	17.20	7,375	5,768	13,143
1913	250	530	780	29.00	12.00	17.40	7,250	6,360	13,610
1914	250	560	810	34.00	15.30	21.10	8,500	8,568	17,068
1915	250	590	840	36.00	16.40	22.20	9,000	9,676	18,676
1916	242	643	885	37.00	16.80	22.30	8,954	10,802	19,756
1917	240	695	935	42.00	20.00	25.60	10,080	13,900	23,980
1918	230	750	980	49.50	24.20	30.10	11,385	18,150	29,535
1919	220	825	1,045	58.00	26.80	33.40	12,760	22,110	34,870
1920	220	730	950	61.00	29.12	36.50	13,420	21,255	34,675
1921	225	706	931	47.00	21.94	28.00	10,575	15,493	26,068
1922	233	679	912	39.00	13.88	20.30	9,087	9,427	18,514
1923	242	660	902	35.00	13.00	18.90	8,470	8,578	17,048
1924	248	636	884	34.00	13.29	19.10	8,432	8,452	16,884
1925	253	618	871	34.00	11.17	17.80	8,602	6,902	15,504
1926	245	591	836	31.00	14.31	19.20	7,595	8,456	16,051
1927	250	569	819	33.00	15.30	20.70	8,250	8,703	16,953
1928	256	554	810	36.00	18.02	23.70	9,216	9,981	19,197
1929	253	566	819	49.00	24.26	31.90	12,397	13,729	26,126
1930	250	586	836	47.00	23.75	30.70	11,750	13,915	25,665
1931	257	612	869	36.00	17.11	22.70	9,252	10,474	19,726
1932	270	650	920	30.00	13.30	18.20	8,100	8,644	16,744
1933	280	706	986	21.00	9.97	13.10	5,880	7,037	12,917
1934	298	772	1,070	23.00	9.54	13.30	6,854	7,362	14,216

Continued

Table 21--(Continued)--Cattle: Number on farms, value per head, and farm value, January 1, 1909-58

Year	Number			Value per head			Farm value		
	Dairy[1]	Other	All	Dairy	Other	All	Dairy	Other	All
	1,000	1,000	1,000	Dollars	Dollars	Dollars	1,000 dollars	1,000 dollars	1,000 dollars
1935	310	815	1,125	24.00	10.45	14.20	7,440	8,515	15,955
1936	310	770	1,080	29.00	14.41	18.60	8,990	11,098	20,088
1937	316	786	1,102	32.00	14.33	19.40	10,112	11,267	21,379
1938	322	803	1,125	32.00	15.33	20.10	10,304	12,308	22,612
1939	329	819	1,148	34.00	16.76	21.70	11,186	13,726	24,912
1940	335	869	1,204	36.00	19.10	23.80	12,060	16,595	28,655
1941	335	881	1,216	37.00	19.81	24.50	12,395	17,454	29,849
1942	342	898	1,240	48.00	26.18	32.20	16,416	23,512	39,928
1943	356	995	1,351	62.00	31.99	39.90	22,072	31,833	53,905
1944	367	1,133	1,500	68.00	34.24	42.50	24,956	38,794	63,750
1945	379	1,182	1,561	68.00	33.27	41.70	25,772	39,322	65,094
1946	368	1,177	1,545	72.00	37.50	45.70	26,496	44,138	70,606
1947	353	1,099	1,452	85.00	45.90	55.40	30,005	66,033	80,441
1948	325	924	1,249	100.00	57.62	68.50	32,500	53,241	85,556
1949	299	925	1,224	122.00	72.48	84.30	36,478	67,044	103,183
1950	308	977	1,285	128.00	73.84	86.30	39,424	84,315	110,896
1951	320	938	1,426	160.00	102.64	117.00	51,200	126,355	166,842
1952	326	1,040	1,540	175.00	123.60	127.00	57,050	128,530	195,580
1953	342	1,491	1,833	150.00	85.24	98.00	52,350	121,208	173,558
1954	352	1,591	1,943	100.00	48.83	59.00	36,600	72,078	108,678
1955	352	1,552	1,904	90.00	44.40	53.00	33,930	62,568	100,912
1956	348	1,575	1,923	96.00	55.50	62.00	33,408	87,546	119,226
1957	345	1,616	1,961	102.00	50.40	61.00	35,190	81,431	119,621
1958	345	1,538	1,883	119.00	75.00	83.00	41,055	115,234	156,289

[1] Cows and heifers 2 years and over kept for milk.

Table 22--Cattle: Number on farms, by classes, 1920-58

Year	All Cattle	Milk animals			Other animals				
		Cows 2 years and over	Heifers 1-2 yrs.	Heifer calves	Cows 2 years and over	Heifers 1-2 yrs.	Other calves	Steers 1 year and over	Bulls 1 year and over
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1920	950	220	50	55	287	74	173	73	18
1921	931	225	49	54	275	71	170	69	18
1922	912	233	48	55	262	68	162	67	17
1923	902	242	47	56	248	65	164	63	17
1924	884	248	46	58	242	62	153	59	16
1925	871	253	44	63	240	60	140	55	16
1926	836	245	43	58	240	59	124	51	16
1927	819	250	43	59	230	55	123	43	16
1928	810	256	44	64	217	51	120	42	16
1929	819	253	46	61	227	50	125	40	17
1930	836	250	49	64	231	51	133	40	18
1931	869	257	53	65	238	56	135	46	19
1932	920	270	57	67	250	61	144	51	20
1933	986	280	62	73	268	69	157	56	21
1934	1,070	298	70	81	284	77	174	64	22
1935	1,125	310	73	87	292	85	187	68	23
1936	1,080	310	69	85	297	82	177	38	22
1937	1,102	316	68	88	292	88	182	46	22
1938	1,125	322	72	95	307	83	175	48	23
1939	1,148	329	79	101	286	93	191	45	24

Continued

Table 22--(Continued)--Cattle: Number on farms, by classes, 1920-58

Year	All cattle	Milk animals			Other animals				
		Cows 2 years and over	Heifers 1-2 yrs.	Heifer calves	Cows 2 years and over	Heifers 1-2 yrs.	Other calves	Steers 1 year and over	Bulls 1 year and over
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1940	1,204	335	88	96	321	104	190	45	25
1941	1,216	335	88	97	328	111	181	51	25
1942	1,240	342	89	99	367	108	167	43	25
1943	1,351	356	91	122	405	115	183	50	29
1944	1,500	367	101	117	458	135	221	67	34
1945	1,561	379	97	114	515	141	203	78	34
1946	1,545	368	96	106	528	131	216	68	32
1947	1,452	353	89	96	504	128	195	57	30
1948	1,249	325	80	84	450	106	140	39	25
1949	1,224	299	70	83	446	107	156	39	24
1950	1,285	308	69	85	475	116	165	81	26
1951	1,426	320	73	95	535	151	181	45	26
1952	1,540	326	83	91	604	170	186	49	31
1953	1,833	342	75	95	713	190	258	56	35
1954	1,943	352	82	97	749	200	249	61	38
1955	1,904	352	91	95	812	193	249	79	38
1956	1,923	348	75	93	865	175	253	75	39
1957	1,961	345	78	93	865	198	271	72	39
1958	1,883	345	77	88	853	178	257	47	38

Table 23—Dairy products: Production, disposition, and income, 1924-57

Year	Number of milk cows on farms[1]	Milk produced per cow	Total production on farms			Total milk used on farms[2]	Total milk utilized for products sold	Cash receipts[3]	Value of home consumption[4]	Gross income from dairy products
			Milk	Butterfat	Butter					
	1,000	Pounds	Million pounds	Million pounds	1,000 pounds	Million pounds	Million pounds	1,000 dollars	1,000 dollars	1,000 dollars
1924	200	2,200	440	19	4,320	268	172	6,899	10,546	17,445
1925	201	2,200	442	19	4,500	260	182	6,780	9,512	16,292
1926	205	2,300	472	21	4,800	276	196	7,586	10,449	18,035
1927	209	2,400	502	22	5,600	297	205	7,806	11,087	18,893
1928	217	2,330	506	22	5,500	296	210	7,931	10,962	18,893
1929	220	2,450	539	24	5,816	297	242	8,668	10,418	19,086
1930	224	2,380	533	23	5,900	304	229	7,937	10,341	18,278
1931	234	2,360	552	24	6,300	321	231	6,597	8,980	15,577
1932	244	2,340	571	25	6,800	336	235	5,040	7,062	12,102
1933	254	2,290	582	26	6,700	341	241	5,188	7,202	12,390
1934	270	2,200	594	26	6,609	349	245	5,743	8,016	13,759
1935	269	2,150	578	25	6,600	349	229	5,883	8,815	14,698
1936	265	2,220	588	26	6,500	349	239	6,344	9,090	15,434
1937	266	2,250	598	26	6,500	350	248	6,848	9,494	16,342
1938	274	2,360	647	28	6,600	363	284	7,195	9,032	16,227
1939	280	2,370	664	29	6,360	376	288	7,179	9,188	16,367
1940	283	2,220	628	28	5,500	347	281	7,611	9,241	16,852
1941	286	2,250	644	29	5,300	341	303	8,643	9,548	18,191
1942	290	2,300	667	30	4,700	318	349	11,594	10,325	21,919
1943	293	2,340	686	31	4,600	323	363	14,331	12,442	26,773
1944	296	2,350	696	31	4,900	326	370	15,159	13,079	28,238

Continued

Table 23--(Continued)--Dairy products: Production, disposition, and income, 1924-57

Year	Number of milk cows on farms1/	Milk produced per cow	Milk	Butterfat	Butter	Total milk used on farms2/	Total milk utilized for products sold	Cash receipts3/	Value of home consumption4/	Gross income from dairy products
	1,000	Pounds	Million pounds	Million pounds	1,000 pounds	Million pounds	Million pounds	1,000 dollars	1,000 dollars	1,000 dollars
1945	296	2,340	693	31	5,700	339	354	14,911	13,706	28,617
1946	290	2,300	667	30	5,500	339	328	17,087	17,297	34,384
1947	278	2,390	679	31	5,200	315	349	22,113	17,575	39,688
1948	260	2,500	695	31	5,000	320	330	26,461	16,432	42,893
1949	258	2,600	720	32	4,800	288	383	26,300	14,322	40,622
1950	282	2,550	719	32	4,600	275	444	26,370	15,800	42,170
1951	296	2,470	731	32	4,300	273	458	29,490	16,937	46,427
1952	304	2,500	768	34	4,200	281	487	33,454	18,618	52,072
1953	308	2,540	806	35	4,200	286	520	33,983	17,985	52,016
1954	310	2,600	806	35	4,000	268	565	33,645	13,580	47,796
1955	304	2,670	812	35	2,800	221	591	33,546	14,281	47,827
1956	299	2,800	837	36	2,300	221	616	35,869	12,280	48,149
1957	297	2,930	870	37	2,200	210	660	37,782	11,440	49,222

1/Average number on farms during year. Heifers not freshened excluded.
2/Includes milk used as milk or cream and as farm butter, and milk fed to calves.
3/Value of combined sales of butter, cream, and milk.
4/Milk and milk equivalent of cream and farm butter consumed, valued at the average returns for milk utilized in dairy products sold. Does not include milk fed to calves.

Table 24--Dairy products: Farm marketings, price, and value, 1924-57

Year	Farm butter sold[1]			Butterfat sold to plants and dealers			Wholesale milk sold to plants and dealers			Milk and cream retailed by farmers			Cash receipts from marketing of all milk and cream
	Quantity	Price per lb.	Value of sales	Quantity	Price per lb.	Value of sales	Quantity	Price per cwt.	Value of sales	Quantity	Price per qt.	Value of sales	
	1,000 pounds	Cents	1,000 dollars	1,000 pounds	Cents	1,000 dollars	Million pounds	Dollars	1,000 dollars	Million quarts	Cents	1,000 dollars	1,000 dollars
1924	500	45	225	320	40	128	88	3.00	2,640	31	12.6	3,906	6,899
1925	550	44	242	280	38	106	97	2.70	2,619	31	12.3	3,813	6,780
1926	600	43	258	360	40	144	108	2.80	3,024	32	13.0	4,160	7,586
1927	700	44	308	520	41	213	111	2.70	2,997	32	13.4	4,288	7,806
1928	700	43	301	640	41	262	112	2.75	3,080	32	13.4	4,288	7,931
1929	713	42	299	960	41	394	134	2.75	3,685	33	13.0	4,290	8,668
1930	600	41	246	800	35	280	130	2.55	3,315	32	12.8	4,096	7,937
1931	600	31	186	1,280	24	307	120	2.10	2,520	32	11.2	3,584	6,597
1932	800	23	184	1,600	16	256	112	1.45	1,624	32	9.3	2,976	5,040
1933	600	22	132	1,560	16	250	122	1.50	1,830	32	9.3	2,976	5,188
1934	600	24	144	1,320	19	251	130	1.70	2,210	33	9.5	3,138	5,743
1935	600	28	168	1,320	24	317	116	1.95	2,262	32	9.8	3,136	5,883
1936	600	29	174	1,320	27	356	126	2.10	2,646	32	9.9	3,168	6,344
1937	620	30	186	1,320	29	383	134	2.25	3,015	32	10.2	3,264	6,848
1938	640	27	173	1,560	23	359	161	2.15	3,462	33	9.7	3,201	7,195
1939	635	26	165	1,600	21	336	164	2.10	3,444	33	9.8	3,234	7,179
1940	500	27	135	1,430	25	358	166	2.30	3,818	33	10.0	3,300	7,611
1941	450	31	140	1,520	30	456	190	2.45	4,655	32	10.6	3,392	8,643
1942	430	35	150	1,480	34	503	236	3.00	7,080	33	11.7	3,861	11,594
1943	370	45	166	1,100	41	451	260	3.65	9,490	33	12.8	4,224	14,331
1944	400	45	180	630	45	284	274	2.75	10,275	34	13.0	4,420	15,159
1945	500	48	240	590	47	277	259	3.80	9,972	33	13.4	4,422	14,911
1946	500	59	295	340	54	184	245	4.93	12,078	30	15.1	4,530	17,087
1947	450	64	288	340	62	211	267	5.71	16,274	30	17.8	5,340	22,113
1948	400	66	264	210	66	139	254	6.26	20,345	29	19.7	5,713	26,461
1949	400	61	244	130	59	77	370	5.75	21,275	24	19.6	4,704	26,300
1950	350	58	203	80	57	46	390	5.61	21,879	21	20.2	4,242	26,370
1951	300	61	183	80	60	48	410	6.14	25,174	19	21.5	4,085	29,490
1952				80	52	50	455	6.55	29,148	19	22.4	4,256	33,454
1953				80	59	47	480	6.23	29,904	18	22.4	4,032	33,983
1954				80	53	42	530	5.67	30,051	16	22.2	3,552	33,645
1955				40	51	20	555	5.63	31,246	10	22.8	2,280	33,546
1956				40	51	20	600	5.71	34,260	7	22.7	1,589	35,869
1957				40	51	20	646	5.63	36,370	6	23.2	1,392	37,782

---

[1] Series on butter discontinued in 1952.

Table 25--Hogs and pigs: Number on farms, value per head, and farm value, January 1, 1909-58

Year	Number	Value per head	Farm value
	1,000 head	Dollars	1,000 dollars
1909	997	4.75	4,376
1910	1,000	5.50	5,500
1911	1,119	6.20	6,938
1912	1,125	5.80	6,525
1913	1,040	7.00	7,280
1914	950	8.00	7,600
1915	935	7.70	7,200
1916	970	7.30	7,081
1917	1,000	9.20	9,200
1918	1,020	13.60	13,872
1919	966	15.20	14,683
1920	851	14.60	12,425
1921	749	11.90	8,913
1922	700	8.80	6,160
1923	650	8.00	5,200
1924	580	7.80	4,524
1925	528	8.60	4,541
1926	496	8.80	4,365
1927	472	10.10	4,767
1928	527	9.20	4,848
1929	586	9.70	5,684
1930	637	8.80	5,606
1931	605	7.30	4,416
1932	758	6.50	4,927
1933	796	4.10	3,264
1934	796	3.90	3,123
1935	777	4.85	3,758
1936	730	7.90	5,782
1937	818	6.70	5,469
1938	834	6.50	5,424
1939	934	5.60	5,230
1940	999	4.80	4,795
1941	849	5.20	4,413
1942	815	8.50	6,950
1943	807	12.00	9,720
1944	1,049	11.10	11,579
1945	902	11.40	10,238
1946	812	14.60	11,855
1947	739	17.50	12,932
1948	724	21.70	15,711
1949	717	21.00	15,057
1950	703	16.00	11,248
1951	619	18.70	11,575
1952	551	18.70	10,304
1953	463	15.30	7,084
1954	366	21.50	8,170
1955	388	18.70	7,256
1956	473	15.20	7,190
1957	501	16.50	8,266
1958	386	20.90	8,067

Table 26--Hogs: January 1 inventory, pig crop, and disposition, 1924-58

Year	On hand January 1	Spring		Fall		In shipments	Marketings	Farm slaughter	Deaths
		Sows farrowed	Pigs saved	Sows farrowed	Pigs saved				
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1924	580	95	428	55	237	-	281	335	101
1925	528	85	434	51	285	3	302	335	117
1926	496	85	442	56	308	4	335	331	112
1927	472	89	459	59	313	5	301	310	111
1928	527	82	410	47	245	6	222	290	90
1929	586	85	442	45	243	4	277	273	88
1930	637	72	378	42	225	5	275	273	92
1931	605	80	434	68	361	3	180	375	110
1932	758	95	498	81	436	1	322	450	125
1933	796	110	560	82	430	2	442	420	130
1934	796	126	634	85	435	1	504	450	135
1935	777	118	590	80	400	2	379	450	210
1936	730	130	642	96	470	3	382	460	185
1937	818	118	590	100	500	3	407	420	250
1938	834	132	660	115	586	5	529	415	207
1939	934	140	686	117	608	7	540	445	251
1940	999	122	598	90	441	7	501	425	270
1941	849	116	580	91	455	7	436	400	240
1942	815	116	592	97	514	7	511	370	240
1943	807	145	740	125	662	18	478	420	280
1944	1,049	146	774	95	494	13	738	390	300
1945	902	124	632	97	524	1	622	375	250
1946	812	118	614	86	430	3	500	385	235
1947	739	101	525	89	472	1	498	330	185
1948	724	94	489	85	459	2	487	310	160
1949	717	97	514	87	470	1	529	290	180
1950	703	85	476	71	419	8	517	270	200
1951	619	73	409	66	376	8	436	250	175
1952	551	73	438	55	319	8	500	195	158
1953	463	51	291	42	248	4	321	180	125
1954	366	45	279	40	240	5	247	140	115
1955	388	54	340	48	293	7	290	150	115
1956	473	60	366	50	305	8	371	165	115
1957	501	55	336	40	240	8	414	160	125
1958	386	40	248	35					

Table 2[illegible].—Hogs: Production, marketing, price, and income, 1924-57

Year	Volume		Season average price per 100 lbs.	Cash receipts	Value of home consumption	Gross income	Cost of inshipments
	Production, cwt.	Sold, cwt.					
	1,000	1,000	Dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1924	978.80	505.8	7.40	4,723	3,212	7,935	-
1925	1,038.65	543.6	8.80	5,949	3,821	9,770	46
1926	1,086.30	603.0	9.40	6,898	4,032	10,930	65
1927	995.95	451.5	9.20	5,281	3,696	8,977	54
1928	873.80	333.0	7.90	3,537	2,969	6,506	56
1929	895.00	415.5	7.90	4,135	2,795	6,930	56
1930	823.50	412.5	7.60	3,955	2,689	6,644	68
1931	1,041.80	270.0	6.10	2,551	2,965	5,516	34
1932	1,228.30	483.0	4.30	2,841	2,508	5,349	9
1933	1,360.07	663.0	3.60	2,986	1,959	4,945	15
1934	1,467.20	756.0	4.00	3,735	2,333	6,068	8
1935	1,253.25	568.5	5.80	4,383	3,341	7,724	22
1936	1,386.80	573.0	6.40	4,892	3,768	8,660	36
1937	1,320.05	651.2	6.70	5,533	3,602	9,135	37
1938	1,633.35	872.85	5.90	6,169	3,134	9,303	56
1939	1,697.80	918.0	5.30	5,847	3,019	8,866	71
1940	1,403.10	851.7	4.60	4,731	2,502	7,233	64
1941	1,329.70	763.0	7.00	6,506	3,584	10,090	89
1942	1,448.75	894.25	10.50	11,006	4,973	15,979	126
1943	1,783.55	875.8	12.20	12,816	6,558	19,374	370
1944	1,778.60	1,322.4	10.40	15,440	5,192	20,632	232
1945	1,637.40	1,142.5	12.30	16,092	6,273	22,365	21
1946	1,542.60	938.9	15.20	16,935	8,193	25,158	75
1947	1,498.60	969.4	20.70	23,175	9,563	32,738	33
1948	1,467.00	934.1	21.10	22,686	9,158	31,844	68
1949	1,450.80	988.1	17.50	19,534	6,902	26,436	28
1950	1,323.70	982.3	16.60	18,229	5,916	24,145	217
1951	1,172.80	847.8	18.70	17,861	6,171	24,032	242
1952	1,142.90	944.7	17.10	17,542	4,268	21,810	223
1953	793.16	587.0	19.10	12,686	4,538	17,224	124
1954	764.66	488.96	20.10	10,552	4,508	15,060	162
1955	937.95	550.90	14.90	8,650	3,906	12,556	172
1956	1,058.12	717.57	13.30	9,966	3,735	13,701	178
1957	911.14	792.54	16.20	13,297	4,054	17,351	212

Table 28--Hog slaughter: Number of head, by months, January 1946-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
							1,000 head						
1946	67.0	46.0	42.0	40.0	21.6	13.6	27.0	15.7	8.1	20.0	40.0	52.0	393.0
1947	37.0	18.0	17.5	17.0	13.0	10.0	11.0	10.0	16.0	20.0	26.0	38.0	233.5
1948	34.0	23.0	24.0	19.0	13.3	8.3	9.1	8.7	12.2	18.0	21.0	29.0	219.6
1949	21.0	20.0	20.0	16.0	10.2	9.6	7.3	10.0	10.4	14.2	19.0	24.0	181.7
1950	21.0	16.0	16.0	12.5	10.0	10.3	7.3	9.4	10.6	13.8	17.0	24.0	167.9
1951	31.0	24.0	24.0	20.0	15.0	12.0	9.6	15.0	16.0	23.0	27.0	29.0	245.6
1952	31.0	25.0	22.0	21.0	15.0	13.6	14.0	16.0	20.0	28.0	25.0	29.0	259.6
1953	28.0	19.0	19.0	16.0	13.0	10.7	10.5	13.2	14.5	17.0	19.0	25.0	204.9
1954	21.0	14.7	13.1	12.6	9.3	9.0	10.5	10.2	14.0	17.0	20.0	26.0	177.4
1955	19.0	17.0	17.0	12.3	11.6	10.6	9.5	10.6	13.5	16.0	22.0	25.0	184.1
1956	21.0	18.0	18.0	16.0	15.0	14.4	12.0	13.5	15.0	20.0	21.0	23.0	206.9
1957	21.0	16.0	14.3	15.0	14.1	10.7	10.9	12.9	14.2	18.0	19.0	21.0	187.1
1958	21.0	15.8	15.8	14.7	14.0	9.6	9.7	10.8					

1/Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 29--Hog slaughter: Average live weight per head, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
							Pounds						
1947	173	181	175	204	203	203	188	186	197	206	200	202	193
1948	190	192	206	202	196	184	187	197	202	207	203	196	198
1949	200	195	198	192	192	192	158	210	191	187	188	182	192
1950	177	194	196	196	200	192	174	188	190	190	201	188	192
1951	199	177	211	175	187	187	179	192	178	188	191	179	188
1952	181	185	176	184	184	191	180	179	190	203	201	187	188
1953	163	182	195	194	178	191	196	182	198	177	195	169	182
1954	193	196	195	199	195	200	200	193	193	203	209	202	197
1955	194	188	192	193	198	201	197	188	196	202	201	198	197
1956	198	197	191	200	199	197	197	194	195	195	205	193	196
1957	197	203	206	200	208	204	210	200	208	201	207	210	204
1958	194	197	205	205	206	203	206	197					

1/Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 30--Hog slaughter: Total live weight, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	Mar.	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
	- - -	- - -	- - -	- - -	- - -	- - -	1,000 pounds	- - -	- - -	- - -	- - -	- - -	- - -
1947	6,408	3,294	3,062	3,469	2,646	2,035	2,063	1,860	3,157	4,120	5,211	7,670	44,995
1948	6,481	4,456	4,943	3,852	2,605	1,530	1,706	1,726	2,470	3,726	4,263	5,684	43,442
1949	4,200	3,900	3,960	3,072	1,958	1,843	1,153	2,100	1,986	2,655	3,647	4,368	34,842
1950	3,806	3,162	3,175	2,450	2,000	1,978	1,270	1,767	2,021	2,617	3,488	4,533	32,267
1951	6,231	4,168	5,054	3,434	2,831	2,236	1,726	2,954	2,765	4,422	5,190	5,102	46,113
1952	5,688	4,604	3,823	3,792	2,847	2,594	2,518	2,934	3,857	5,649	4,992	5,483	48,781
1953	4,568	3,468	3,646	3,094	2,315	2,042	2,050	2,411	2,882	2,934	3,628	4,290	37,328
1954	3,966	2,895	2,563	2,515	1,815	1,809	2,108	1,974	2,702	3,373	4,124	5,183	35,027
1955	3,666	3,269	3,293	2,368	2,298	2,137	1,873	1,997	2,646	3,336	4,385	4,992	36,260
1956	4,115	3,501	3,355	3,143	3,075	2,842	2,366	2,632	2,929	3,836	4,325	4,506	40,625
1957	4,189	3,203	2,952	3,065	2,937	2,189	2,287	2,579	2,967	3,620	3,887	4,334	38,209
1958	4,169	3,113	3,239	3,014	2,884	1,949	1,998	2,128					

---

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 31--Sheep and lambs: Number on farms, value per head, and farm value, January 1, 1909-58

Year	Number	Value per head	Farm value
	1,000 head	Dollars	1,000 dollars
1909	183	1.80	329
1910	185	1.90	352
1911	186	1.80	335
1912	187	2.00	374
1913	190	2.00	380
1914	195	2.20	429
1915	200	2.20	440
1916	210	2.30	483
1917	219	2.90	635
1918	225	4.10	922
1919	228	5.20	1,186
1920	230	5.40	1,242
1921	225	3.80	855
1922	225	2.80	630
1923	230	2.90	667
1924	235	3.10	728
1925	235	3.20	752
1926	235	3.00	705
1927	240	3.00	720
1928	240	3.00	720
1929	245	3.30	808
1930	250	3.40	850
1931	255	2.70	688
1932	260	2.70	702
1933	265	2.00	530
1934	270	2.20	594
1935	275	2.65	727
1936	248	3.20	788
1937	260	3.10	812
1938	268	3.05	822
1939	276	3.00	823
1940	282	3.10	881
1941	282	3.10	880
1942	296	3.95	1,166
1943	257	4.40	1,137
1944	231	4.40	1,016
1945	226	4.45	1,006
1946	217	4.45	966
1947	176	5.60	986
1948	143	5.60	801
1949	107	6.60	706
1950	98	7.90	774
1951	104	9.50	988
1952	104	11.80	1,227
1953	108	10.60	1,145
1954	111	8.70	966
1955	115	8.80	1,012
1956	110	8.90	979
1957	99	8.90	881
1958	95	11.60	1,108

Table 32--Sheep and lambs: January 1 inventory, lamb crop, and disposition, 1924-58

Year	On hand Jan. 1	Lambs	In-shipments		Marketings[1]		Farm slaughter		Deaths	
	All-sheep and lambs	saved	Sheep	Lambs	Sheep	Lambs	Sheep	Lambs	Sheep	Lambs
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1924	235	70	-	-	12	25	1	2	20	10
1925	235	70	2	-	24	15	1	2	20	10
1926	235	67	-	-	17	12	1	2	20	10
1927	240	76	2	-	26	20	1	1	20	10
1928	240	74	1	-	18	20	2	-	20	10
1929	245	79	1	-	18	25	-	2	20	10
1930	250	80	-	-	14	29	1	1	20	10
1931	255	73	-	-	18	17	1	2	20	10
1932	260	86	2	-	24	24	1	4	20	10
1933	265	112	-	-	22	49	2	4	20	10
1934	270	100	-	-	22	20	2	6	30	15
1935	275	80	-	-	44	21	3	5	23	11
1936	248	93	-	-	11	26	3	4	25	12
1937	260	87	-	-	14	25	3	4	24	9
1938	268	100	1	-	17	32	2	3	26	13
1939	276	101	-	1	18	37	2	3	27	9
1940	282	94	-	-	30	23	2	3	25	11
1941	282	109	-	-	18	19	2	3	31	22
1942	296	83	-	-	35	14	2	3	45	23
1943	257	76	-	-	28	14	2	3	43	12
1944	231	72	-	-	22	8	2	3	28	14
1945	226	76	-	-	18	14	2	3	33	15
1946	217	69	-	-	44	10	2	3	30	17
1947	176	58	-	-	34	16	2	3	25	11
1948	143	52	-	-	38	13	2	3	20	12
1949	107	43	4	1	15	11	2	2	14	8
1950	98	40	-	2	4	5	2	2	13	10
1951	104	38	-	-	6	1	2	2	13	10
1952	104	48	1	1	2	8	2	2	14	8
1953	108	50	-	-	14	11	2	2	14	7
1954	111	47	-	1	8	10	2	2	14	8
1955	115	52	-	1	22	12	2	2	11	9
1956	110	49	-	1	19	12	2	2	14	12
1957	99	44	-	1	14	11	2	2	11	9
1958	95									

Table 33 —Sheep and lambs: Number on farms, by classes, January 1, 1920-58

Year	Sheep					
	All	Lambs		One year and older		
		Ewes	Wethers and rams	Ewes	Rams	Wethers
	1,000 head	1,000 head	1,000 head	1,000 head	1,000 head	1,000 head
1920	230	1/	1/	146	12	32
1921	225	1/	1/	143	12	31
1922	225	1/	1/	143	12	31
1923	230	1/	1/	147	10	33
1924	235	1/	1/	148	8	38
1925	235	24	19	148	9	35
1926	235	24	19	148	11	33
1927	240	24	19	151	12	34
1928	240	26	19	154	12	29
1929	245	24	20	159	12	30
1930	250	25	17	168	12	28
1931	255	26	18	168	13	30
1932	260	26	18	172	13	31
1933	265	29	19	172	13	32
1934	270	27	22	173	13	35
1935	275	28	22	173	14	38
1936	248	24	19	162	13	30
1937	260	28	23	166	13	30
1938	268	27	22	173	13	33
1939	276	30	22	177	14	33
1940	282	30	23	180	16	33
1941	282	32	25	173	16	36
1942	296	35	30	163	16	52
1943	257	26	23	147	14	47
1944	231	25	22	134	12	38
1945	226	25	22	128	12	39
1946	217	23	21	125	12	36
1947	176	18	17	106	9	26
1948	143	15	13	92	7	16
1949	107	13	11	63	5	15
1950	98	12	10	63	4	9
1951	104	14	11	66	4	9
1952	104	15	11	70	4	9
1953	108	17	13	77	5	10
1954	111	17	13	80	5	7
1955	115	18	10	74	5	8
1956	110	19	11	70	5	5
1957	99	15	9	65	5	5
1958	95	15	8	62	5	5

1/No break down for ewes and wethers for the years 1920-24. Total lambs were 40, 39, 39, 40, and 41 respectively.

Table 34.—Sheep and lambs: Production, marketings, price, and income, 1924-57

Year	Production	Marketing[1]	Price per cwt.		Cash receipts	Value of home consumption	Gross income	Cost of in shipments
			Sheep	Lambs				
	1,000 pounds	1,000 pounds	Dollars	Dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1924	2,420	2,330	5.10	6.60	143	7	150	-
1925	2,920	2,910	6.30	8.10	205	8	213	12
1926	2,790	2,130	5.40	7.30	133	7	140	-
1927	3,170	3,340	5.70	7.60	214	5	219	11
1928	3,210	2,620	6.90	8.90	207	7	214	6
1929	3,444	2,924	6.70	9.00	229	5	234	5
1930	3,295	2,752	5.70	7.30	185	5	190	-
1931	3,177	2,524	4.30	6.50	132	6	138	-
1932	3,845	3,432	3.40	4.15	132	6	138	5
1933	5,322	4,496	3.05	4.20	173	8	181	-
1934	3,982	3,046	3.05	3.75	109	10	119	-
1935	3,431	5,142	3.35	5.00	201	12	213	-
1936	3,562	2,323	3.95	5.80	128	13	141	-
1937	3,895	2,580	4.05	5.50	136	13	149	-
1938	4,075	3,215	3.80	5.60	160	8	168	3
1939	4,370	3,560	3.75	5.50	175	8	183	4
1940	4,210	4,000	4.00	5.60	187	9	196	-
1941	4,174	2,734	4.25	6.00	143	10	153	-
1942	1,425	4,025	5.40	7.30	243	12	255	-
1943	1,554	3,584	6.20	8.40	255	14	269	-
1944	2,508	2,608	6.20	8.40	187	14	201	-
1945	2,134	2,514	6.50	9.70	202	15	217	-
1946	1,760	4,880	6.90	11.00	377	16	393	-
1947	1,510	3,980	7.10	13.60	354	18	372	-
1948	1,577	4,347	8.80	15.00	451	22	473	-
1949	1,630	2,140	9.00	16.30	261	18	279	53
1950	1,298	708	10.30	17.20	116	21	137	35
1951	1,298	658	12.60	23.60	118	27	145	19
1952	1,914	694	10.60	22.40	157	24	181	9
1953	2,312	2,052	8.30	17.30	251	18	269	-
1954	2,607	1,472	8.00	17.20	192	26	218	11
1955	3,196	3,011	6.80	18.00	310	28	338	11
1956	2,142	2,732	6.30	16.20	267	27	294	11
1957	2,091	2,181	7.10	17.40	248	30	278	13

[1] Excludes interfarm sales.

Table 35--Sheep and lamb slaughter: Number of head, by months, January 1946-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
							Number						
1946	100	100	100	100	100	200	200	300	100	100	100	100	1,600
1947	—	100	100	200	200	300	300	300	300	300	300	400	2,800
1948	200	200	100	300	600	900	400	500	400	400	400	300	4,700
1949	100	100	200	200	400	900	1,000	600	400	300	600	400	5,200
1950	100	200	200	200	300	300	400	300	200	100	200	200	2,700
1951	100	100	200	100	100	200	200	200	200	200	100	---	1,700
1952	100	100	100	100	100	100	100	100	100	100	100	---	1,100
1953	100	100	200	100	100	200	100	100	---	---	200	100	1,300
1954	100	100	200	200	300	300	300	100	100	100	100	100	2,000
1955	100	100	100	200	200	200	100	100	100	100	100	200	1,600
1956	100	100	300	100	200	200	200	200	300	300	200	200	2,400
1957	100	100	300	200	100	200	200	100	100	100	100	200	1,800
1958	100	100	100	100	200	200	300	200					

Table 36--Sheep and lamb slaughter: Average live weight per head, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
							Pounds						
1947	--	67	90	89	79	85	63	72	77	70	75	65	75
1948	71	80	76	92	89	86	87	81	86	79	72	84	83
1949	91	73	73	75	72	92	85	79	82	81	81	77	81
1950	75	80	67	71	79	88	79	83	77	84	74	73	76
1951	72	82	87	74	86	82	77	76	80	80	77	--	81
1952	92	89	90	83	89	83	85	92	75	80	90	--	86
1953	88	85	100	104	77	73	69	66	--	--	83	75	76
1954	75	75	75	70	81	80	78	82	86	90	80	75	80
1955	90	83	93	97	88	80	93	84	90	100	82	92	92
1956	88	89	85	93	80	74	79	85	85	90	91	79	81
1957	89	88	85	90	86	88	82	88	91	93	88	93	86
1958	89	91	77	83	79	77	69	65					

---

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 37—Sheep and lamb slaughter: Total live weight, by months, January 1947-August 1958[1]

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
	- - -	- - -	- - -	- - -	- - -	- - -	1,000 pounds	- - -	- - -	- - -	- - -	- - -	- - -
1947	—	6	9	18	16	27	17	21	26	23	22	26	211
1948	14	16	8	23	58	79	31	43	30	33	29	26	390
1949	10	8	15	15	28	83	81	44	37	29	46	27	423
1950	7	16	10	12	22	29	34	25	16	12	10	12	205
1951	9	8	13	10	9	14	17	16	16	16	10	—	138
1952	9	8	9	10	8	7	9	10	8	8	9	—	95
1953	7	11	15	12	8	13	6	8	—	—	13	6	99
1954	8	8	17	14	21	28	21	9	9	9	8	8	160
1955	10	8	13	21	16	17	9	9	9	8	9	18	147
1956	7	8	23	10	16	14	15	17	22	27	20	16	195
1957	8	10	22	18	12	14	14	10	8	12	9	18	155
1958	8	9	8	8	16	15	21	13					

---

[1] Includes slaughter under Federal inspection and other wholesale and retail slaughter; excludes farm slaughter. Averages based on unrounded numbers.

Table 38--Wool: Production, price, and value, 1909-58

Year	Sheep shorn	Weight per fleece	Production	Season average price per pound	Farm value
	1,000	Pounds	1,000 pounds	Cents	1,000 dollars
1909	150	3.2	480	21	101
1910	152	3.2	486	22	107
1911	153	3.7	566	16	91
1912	153	4.1	627	16	100
1913	156	3.5	546	14	76
1914	160	4.0	640	14	90
1915	164	3.7	607	15	91
1916	172	3.7	636	21	134
1917	180	3.6	648	35	227
1918	184	3.7	681	44	300
1919	187	3.3	617	37	228
1920	189	3.3	624	28	175
1921	185	3.1	574	12	69
1922	185	3.1	574	15	86
1923	188	3.1	583	20	117
1924	193	3.2	618	28	173
1925	193	3.3	637	39	248
1926	193	3.2	618	27	167
1927	200	3.3	660	26	172
1928	215	3.2	688	33	227
1929	200	3.2	640	32	205
1930	215	3.4	731	23	168
1931	210	3.6	756	13	98
1932	210	3.6	756	7	53
1933	213	3.5	746	16	119
1934	215	3.4	731	21	154
1935	234	3.3	772	20	154
1936	210	3.4	714	23	164
1937	220	3.3	726	30	218
1938	225	3.3	742	20	148
1939	235	3.3	776	21	163
1940	240	3.3	792	24	190
1941	243	3.4	826	34	281
1942	255	3.2	816	38	310
1943	221	3.2	707	42	297
1944	196	3.2	627	48	301
1945	192	3.3	634	48	304
1946	184	3.2	589	48	283
1947	150	3.4	510	43	219
1948	122	3.4	415	45	187
1949	91	3.5	318	45	143
1950	83	3.4	282	55	155
1951	88	3.2	282	104	293
1952	88	4.0	352	52	183
1953	94	4.1	385	57	219
1954	97	4.1	398	56	223
1955	100	4.4	440	45	198
1956	99	4.4	436	39	170
1957	89	4.5	400	51	204
1958	86	4.7	404		

Table 39 --Workstock: Number on farms, value per head, and total value, 1910-58

Year	Horses Number	 Value per head	 Farm value	Mules Number	 Value per head	 Farm value	Total workstock	Total value
	1,000	Dollars	1,000 dollars	1,000 head	Dollars	1,000 dollars	1,000	1,000 dollars
1910	178	79	14,062	132	116	15,312	310	29,374
1911	175	83	14,525	133	119	15,827	308	30,352
1912	170	79	13,430	134	116	15,544	304	28,974
1913	170	87	14,790	135	127	17,145	305	31,935
1914	171	85	14,535	138	128	17,664	309	32,199
1915	175	83	14,525	140	125	17,500	315	32,025
1916	180	82	14,760	145	121	17,545	325	32,305
1917	195	86	16,770	165	125	20,625	360	37,395
1918	198	93	18,414	180	135	24,300	378	42,714
1919	195	97	18,915	185	145	26,825	380	45,740
1920	182	108	19,690	185	168	31,046	367	50,736
1921	174	85	14,867	187	143	26,731	361	41,598
1922	157	78	12,244	177	118	20,871	334	33,115
1923	150	72	10,742	176	113	19,856	326	30,598
1924	146	67	9,782	180	94	16,836	326	26,618
1925	143	62	8,866	180	90	16,200	323	25,066
1926	139	55	7,645	182	90	16,380	321	24,025
1927	135	49	6,615	186	79	14,694	321	21,309
1928	132	52	6,864	186	85	15,810	318	22,674
1929	130	53	6,890	192	89	17,088	322	23,978
1930	128	52	6,656	201	85	17,085	329	23,741
1931	126	46	5,796	205	74	15,170	331	20,966
1932	124	38	4,712	201	63	12,663	325	17,375
1933	123	32	3,936	197	56	11,032	320	14,968
1934	122	40	4,848	199	70	13,850	321	18,698
1935	122	45	5,515	199	84	16,618	321	22,133
1936	122	56	6,843	199	99	19,791	321	26,634
1937	123	65	7,951	197	110	21,670	320	29,621
1938	128	64	8,205	195	113	22,035	323	30,240
1939	137	60	8,220	191	111	21,201	328	29,421
1940	145	59	8,555	187	109	20,383	332	28,938
1941	146	58	8,403	183	102	18,672	329	27,075
1942	147	61	8,954	179	104	18,631	326	27,585
1943	146	69	10,103	168	118	19,756	314	29,859
1944	146	74	10,824	166	130	21,537	312	32,361
1945	145	71	10,295	161	122	19,642	306	29,937
1946	139	71	9,869	148	116	17,168	287	27,037
1947	135	68	9,180	142	117	16,614	277	25,794
1948	128	68	8,704	136	111	15,096	264	23,800
1949	123	52	6,396	126	89	11,214	249	17,610
1950	121	47	5,687	115	79	9,085	236	14,772
1951	120	34	4,080	109	56	6,104	229	10,184
1952	109	31	3,379	100	50	5,000	209	8,379
1953	101	30	3,030	92	44	4,048	193	7,078
1954	96	30	2,880	82	43	3,526	178	6,406
1955	92	29	2,668	71	40	2,840	152	5,168
1956	1/	1/	1/	1/	1/	1/	138	5,658
1957							123	6,396
1958							109	6,540

1/The break down was discontinued.

Table 40 --Horses and mules: Number on farms, by classes, January 1, 1910-58

Year	Total	2 years old and over	Under 2 years old	Total value
	1,000 head	1,000 head	1,000 head	1,000 dollars
1910	310	-	-	29,374
1911	308	-	-	30,352
1912	304	-	-	28,974
1913	305	-	-	31,935
1914	309	-	-	32,199
1915	315	-	-	32,025
1916	325	-	-	32,305
1917	360	-	-	37,395
1918	378	-	-	42,714
1919	380	-	-	45,740
1920	367	339	28	50,736
1921	361	338	23	41,598
1922	334	315	19	33,115
1923	326	310	16	30,598
1924	326	313	13	26,618
1925	323	309	14	25,066
1926	321	307	14	24,025
1927	321	307	14	21,309
1928	318	306	12	22,674
1929	322	312	10	23,978
1930	329	320	9	23,741
1931	331	322	9	20,966
1932	325	319	6	17,375
1933	320	314	6	14,968
1934	321	312	9	18,698
1935	321	310	11	22,133
1936	321	310	11	26,634
1937	320	309	11	29,621
1938	323	308	15	30,240
1939	328	310	18	29,421
1940	332	313	19	28,938
1941	329	318	21	27,075
1942	326	308	18	27,585
1943	314	298	16	29,859
1944	312	298	14	32,361
1945	306	292	14	29,937
1946	287	273	14	27,037
1947	274	264	13	25,794
1948	257	252	12	23,800
1949	241	239	10	17,610
1950	236	228	8	14,772
1951	229	221	8	10,184
1952	209	201	8	8,379
1953	193	186	7	7,078
1954	178	172	6	6,406
1955	152	146	6	5,168
1956	138	132	6	5,658
1957	123	116	7	6,396
1958	109	102	7	6,540

Table 41--All chickens[1]: Number on farms, value per head, and farm value, January 1, 1924-58

Year	Number on farms			Total	Value per head	Farm value
	Hens	Pullets	Other chickens[1]			
	1,000 head	1,000 head	1,000 head	1,000 head	Dollars	1,000 dollars
1924	3,577	-	793	4,370	.76	3,321
1925	3,470	-	761	4,231	.67	2,835
1926	3,608	-	792	4,400	.77	3,388
1927	4,119	-	904	5,023	.76	3,817
1928	4,107	-	902	5,009	.77	3,857
1929	4,036	-	826	4,862	.81	3,938
1930	2,100	2,110	1,300	5,510	.85	4,684
1931	1,785	2,215	1,170	5,170	.63	3,257
1932	1,535	2,038	1,299	4,872	.57	2,777
1933	1,658	1,936	1,000	4,594	.38	1,746
1934	1,542	1,974	1,092	4,608	.40	1,843
1935	1,557	1,856	1,048	4,461	.48	2,141
1936	1,557	2,023	1,006	4,586	.56	2,568
1937	1,619	2,347	1,107	5,073	.55	2,790
1938	1,651	2,042	996	4,689	.58	2,720
1939	1,717	2,287	1,135	5,139	.58	2,981
1940	1,841	2,542	1,179	5,562	.54	3,003
1941	1,823	2,364	1,096	5,283	.59	3,117
1942	1,969	2,766	1,370	6,105	.71	4,335
1943	2,127	3,098	1,576	6,801	.94	6,393
1944	2,276	3,470	1,513	7,259	1.15	8,348
1945	2,185	2,741	1,226	6,152	1.21	7,444
1946	2,076	2,823	1,349	6,248	1.31	8,185
1947	1,910	2,484	1,120	5,514	1.45	7,995
1948	1,738	2,310	1,008	5,056	1.45	7,331
1949	1,668	2,518	1,058	5,244	1.55	8,128
1950	1,601	2,568	1,026	5,195	1.40	7,273
1951	1,649	2,208	1,097	4,954	1.45	7,183
1952	1,501	2,318	932	4,751	1.50	7,126
1953	1,471	1,970	820	4,261	1.40	5,965
1954	1,324	1,812	648	3,784	1.40	5,298
1955	1,192	1,848	609	3,649	1.20	4,379
1956	1,240	1,756	518	3,514	1.25	4,392
1957	1,277	1,774	559	3,610	1.15	4,152
1958	1,213	1,632	430	3,275	1.20	3,930

---

[1] Does not include commercial broilers.

Table 42 --Farm chickens: January 1 inventory, production, disposition, price, and income, 1924-58

Year	All chickens on farms	Number					Produced	Consumed on farms	Sold	Price2/		Cash receipts	Value of home consumption	Gross income
		Raised	Lost	Produced1/	Consumed on farms	Sold				Per pound	Per head			
	1,000	1,000	1,000	1,000	1,000	1,000	1,000 pounds	1,000 pounds	1,000 pounds	Cents	Cents	1,000 dollars	1,000 dollars	1,000 dollars
1924	4,370	6,583	614	5,969	3,750	2,358	20,892		8,253		77	1,816	2,888	4,704
1925	4,231	6,750	550	6,200	3,800	2,231	21,700		7,808		78	1,740	2,964	4,704
1926	4,400	7,626	572	7,054	4,000	2,431	24,689		8,508		81	1,969	3,240	5,209
1927	5,023	7,509	653	6,856	3,950	2,920	24,682		10,512		83	2,424	3,278	5,702
1928	5,009	7,208	701	6,507	3,860	2,794	23,425		10,058		83	2,319	3,204	5,523
1929	4,862	8,101	681	7,420	4,000	2,772	26,712		9,979		84	2,328	3,360	5,688
1930	5,510	8,480	771	7,709	4,167	3,882	27,752		13,975		74	2,873	3,084	5,957
1931	5,170	7,615	776	6,839	4,386	2,751	25,304		10,179		61	1,678	2,675	4,353
1932	4,872	7,615	731	6,884	4,726	2,436	24,094		8,526		44	1,072	2,079	3,151
1933	4,594	7,539	735	6,804	5,104	1,686	24,494		6,070		39	658	1,991	2,649
1934	4,608	7,237	691	6,546	6,133	560	23,566		2,016		44	246	2,699	2,945
1935	4,461	7,070	625	6,445	5,748	572	23,846		2,116		54	309	3,104	3,413
1936	4,586	7,810	688	7,122	5,883	752	25,299	20,5903/	2,858		62	466	3,647	4,113
1937	5,073	7,470	761	6,709	5,794	1,299	22,597	19,120	4,936		59	766	3,418	4,184
1938	4,689	7,870	703	7,167	6,035	682	24,218	19,916	2,592		59	402	3,561	3,963
1939	5,139	9,032	822	8,210	5,932	1,855	27,777	19,576	6,678		55	1,020	3,263	4,283
1940	5,562	8,219	834	7,385	4,863	2,801	25,128	16,048	10,084	15.4		1,553	2,471	4,024
1941	5,283	9,616	898	8,718	5,076	2,820	31,241	17,766	10,434	17.6		1,836	3,127	4,963
1942	6,105	10,097	1,099	8,998	5,251	3,051	32,617	18,378	11,594	22.1		2,562	4,062	6,624
1943	6,801	11,914	952	10,962	5,013	5,491	39,558	17,546	20,317	28.9		5,872	5,071	10,943
1944	7,259	9,889	1,307	8,582	4,392	5,297	33,010	16,250	21,188	28.4	115	6,017	4,615	10,682
1945	6,152	9,889	1,046	8,843	4,495	4,252	32,719	16,632	15,732	31.7	121	4,987	5,272	10,259
1946	6,248	8,900	1,125	7,775	4,643	3,866	29,581	17,179	14,691	34.3	131	5,039	5,892	10,931
1947	5,514	8,455	937	7,518	4,337	3,639	27,382	15,613	13,464	36.0	145	4,847	5,621	10,468
1948	5,056	8,624	860	7,764	4,264	3,312	28,650	15,350	12,586	37.0	145	4,657	5,680	10,337
1949	5,244	9,486	944	8,542	4,318	4,273	32,028	15,977	16,237	35.0	155	5,683	5,592	11,215
1950	5,195	8,253	1,039	7,214	4,663	2,760	27,457	8,752	12,515	28.0	140	3,091	6,076	9,167
1951	4,954	8,005	997	7,008	4,663	2,341	26,167	16,787	9,364	29.1	145	2,725	4,885	7,610
1952	4,751	8,005	1,098	6,907	4,430	2,890	25,608	15,948	11,271	29.5	150	3,325	4,705	8,030
1953	4,261	6,484	1,098	5,386	4,253	1,434	18,907	14,035	6,166	29.3	140	1,807	4,112	5,919
1954	3,784	5,485	832	4,653	3,530	1,258	15,772	10,943	5,409	24.3	140	1,314	2,659	3,973
1955	3,649	4,717	949	3,768	3,177	726	12,589	10,166	2,977	24.5	120	729	2,491	3,220
1956	3,514	4,717	843	3,874	3,304	474	12,408	10,242	1,801	22.8	125	411	2,335	2,746
1957	3,610	4,009	866	3,143	2,941	537	9,945	9,117	2,202	21.2	115	467	1,933	2,400
1958	3,275										120			

1/Chickens sold plus consumed in household of farm producers, and change in inventory. 2/Prior to 1940 price per head used to compute values.

3/No weights per bird consumed prior to 1936

Table 43--Chicks hatched in commercial hatcheries, by months, January 1938-September 1958

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
							1,000						
1938	121	304	430	333	250	73	71	106	102	100	87	106	2,083
1939	146	374	526	412	307	90	87	131	123	123	110	131	2,560
1940	159	225	460	421	324	133	69	74	108	108	106	113	2,300
1941	192	346	676	683	536	315	98	98	136	136	144	140	3,500
1942	230	515	817	801	780	617	219	178	219	265	255	204	5,100
1943	671	971	1,272	1,206	1,186	671	425	153	207	294	271	219	7,546
1944	418	938	1,286	1,157	809	204	27	43	102	112	144	118	5,358
1945	305	780	1,008	1,041	758	453	196	125	136	196	240	213	5,451
1946	404	842	1,076	1,141	553	35	35	85	145	214	269	184	4,983
1947	367	724	1,066	1,132	612	260	128	92	117	250	255	97	5,100
1948	198	599	1,056	1,132	639	274	178	127	188	218	289	178	5,076
1949	327	792	1,186	1,125	843	402	152	134	217	339	384	117	6,018
1950	397	817	1,347	1,123	594	293	128	197	336	549	447	230	6,458
1951	463	836	1,088	1,229	856	370	216	258	307	626	586	400	7,235
1952	661	1,106	1,371	1,196	665	370	201	265	496	738	598	508	8,175
1953	608	868	1,190	1,071	633	423	297	402	572	652	742	742	8,200
1954	735	854	1,158	1,159	788	560	659	674	792	826	741	605	9,551
1955	620	877	1,016	1,072	885	680	811	799	821	923	910	844	10,258
1956	924	1,085	1,197	1,219	1,256	1,072	1,064	1,012	1,114	1,140	1,182	1,043	13,308
1957	1,184	1,470	1,782	1,655	1,529	1,354	1,338	1,228	1,296	1,207	1,112	1,080	16,218
1958	1,352	1,526	1,737	1,768	1,903	1,781	1,571	1,479	1,324				

Table 44--Commercial broilers: Production, price and value, 1934-57

Year	Production		Price per pound	Gross income	Total sale of chickens and commercial broilers		
	Number	Volume			Thousand lbs. sold	Price per lb.	Value of sale
	1,000	1,000 pounds	Cents	1,000 dollars	1,000	Cents	1,000 dollars
1934	250	575	18.5	106	2,016	12.2	246
1935	300	690	19.0	131	2,116	14.6	309
1936	350	805	18.1	146	2,858	16.3	466
1937	400	960	21.5	206	4,936	15.5	766
1938	450	1,080	18.6	201	2,592	15.5	402
1939	500	1,100	17.0	187	6,678	15.3	1,020
1940	600	1,380	18.0	248	10,084	15.4	1,553
1941	700	1,610	19.5	314	10,434	17.6	1,836
1942	1,100	2,420	26.0	629	11,594	22.1	2,562
1943	1,540	3,234	31.0	1,003	20,317	28.9	5,872
1944	1,232	3,203	33.0	1,057	21,188	28.4	6,017
1945	1,540	3,542	35.0	1,240	19,274	32.3	6,227
1946	1,309	3,011	39.0	1,174	17,702	35.1	6,213
1947	1,244	3,234	41.0	1,326	16,698	37.0	6,173
1948	1,493	3,732	43.0	1,605	16,318	38.4	6,262
1949	1,866	5,038	36.0	1,814	21,275	35.2	7,479
1950	2,146	5,794	30.2	1,750	16,832	28.8	4,841
1951	4,507	12,620	31.0	3,912	21,984	30.2	6,637
1952	8,113	22,716	29.5	6,701	33,987	29.5	10,026
1953	11,358	30,667	27.0	8,280	36,833	27.4	10,087
1954	11,437	34,311	23.0	7,892	39,720	23.2	9,206
1955	11,666	34,998	25.3	8,854	37,975	25.2	9,583
1956	15,716	48,720	19.6	9,549	50,521	19.7	9,960
1957	17,428	52,284	18.8	9,829	54,486	18.9	10,296

Table 45--Broilers: Eggs set and chicks placed, by months, October 1954-September 1958

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	- - -	- - -	- - -	- - -	- - -	- - -	- - -Thousands	- - -	- - -	- - -	- - -	- - -	- - -
							Eggs set for broilers						
1954										995	702	485	
1955	672	612	683	838	663	684	978	716	827	1,062	809	917	9,461
1956	827	733	1,075	992	1,083	1,325	1,008	1,035	1,412	999	1,130	1,315	12,934
1957	1,458	1,672	2,007	1,597	1,555	1,937	1,550	1,878	1,570	1,221	1,714	1,390	19,549
1958	1,635	1,830	2,220	2,005	2,612	1,947	1,882	2,070	1,641				
							Broiler chicks placed						
1954										1,032	708	667	
1955	791	919	1,038	1,360	1,068	1,189	1,309	986	904	1,244	1,227	1,428	13,463
1956	1,062	1,227	1,532	1,473	1,467	1,889	1,315	1,304	1,335	1,079	1,011	1,316	16,010
1957	1,227	1,375	1,924	1,453	1,469	1,991	1,491	1,762	1,537	1,397	1,326	1,158	18,110
1958	1,377	1,698	2,218	1,840	2,564	1,976	1,803	2,103	1,459				

Table 46--Turkeys: Number on farms, value per head, and farm value, January 1, 1929-58

Year	Number	Value per head	Farm value
	1,000 Head	Dollars	1,000 dollars
1929	21	5.10	107
1930	23	3.75	86
1931	24	2.80	67
1932	28	1.90	53
1933	34	1.40	48
1934	34	1.45	49
1935	32	2.05	66
1936	38	2.65	101
1937	38	2.40	91
1938	38	2.50	95
1939	32	2.50	80
1940	40	2.30	92
1941	34	2.40	82
1942	28	3.10	87
1943	23	3.90	90
1944	22	5.10	112
1945	18	5.30	95
1946	18	6.00	108
1947	17	6.20	105
1948	19	6.50	124
1949	16	7.40	118
1950	17	6.20	105
1951	24	6.10	110
1952	31	6.20	130
1953	38	6.00	126
1954	37	5.80	116
1955	37	5.30	196
1956	39	5.30	207
1957	41	4.50	184
1958	31	4.50	140

Table 47—Turkeys: January 1 inventory, production, disposition, price, and income, 1929-58

Year	All turkeys on farms	Number raised	Number lost	Number produced	Number consumed on farms	Number sold	Produced	Consumed on farms	Sold	Price		Cash receipts	Value of home consumption	Gross income
										Per pound	Per head			
	1,000	1,000	1,000	1,000	1,000	1,000	1,000 pounds	1,000 pounds	1,000 pounds	Cents	Dollars	1,000 dollars	1,000 dollars	1,000 dollars
1929	21	30	2	28	14	12	344	172	148	-	3.65	44	51	95
1930	23	40	2	38	14	23	475	175	288	-	3.67	84	51	135
1931	24	50	3	47	15	28	597	190	356	-	2.65	74	40	114
1932	28	65	3	62	16	40	800	206	516	-	2.27	91	36	127
1933	34	62	4	58	14	44	759	183	576	-	1.91	84	27	111
1934	34	60	4	56	15	43	745	200	572	-	1.91	82	29	111
1935	32	60	3	57	14	37	770	189	500	-	2.35	87	33	120
1936	38	65	4	61	13	48	878	187	691	-	2.87	138	37	175
1937	38	73	5	68	13	55	925	177	748	-	2.73	150	35	185
1938	38	58	4	54	14	46	702	182	598	-	2.67	123	37	160
1939	32	62	4	58	14	36	812	196	504	-	2.44	88	34	122
1940	40	61	4	57	11	52	781	151	712	18.0	2.30	128	27	155
1941	34	59	3	56	9	53	817	131	774	22.5	2.40	174	29	203
1942	28	55	3	52	8	49	743	114	701	29.5	3.10	207	34	241
1943	23	53	3	50	7	44	710	99	625	36.0	3.90	225	36	261
1944	22	46	3	43	8	39	624	116	566	37.5	5.10	212	44	256
1945	18	51	3	48	11	37	729	167	562	39.4	5.30	221	66	287
1946	18	51	4	47	15	33	720	230	505	42.2	6.00	213	97	310
1947	17	56	2	54	14	38	815	211	574	45.7	6.20	262	96	358
1948	19	53	2	51	19	35	790	294	542	50.9	6.50	276	150	426
1949	16	71	2	69	23	45	1,104	368	720	44.1	7.40	318	162	480
1950	17	85	2	85	17	65	1,229	252	962	44.9	6.20	432	113	545
1951	24	106	2	104	20	81	1,560	300	1,215	46.7	6.10	567	140	707
1952	31	122	1	121	17	104	1,718	241	1,477	44.8	6.20	662	108	770
1953	38	112	1	111	20	92	1,865	336	1,546	40.1	6.00	620	135	755
1954	37	112	2	110	32	78	1,837	534	1,303	35.9	5.80	468	192	660
1955	37	71	2	76	35	39	1,285	592	659	37.1	5.30	244	220	464
1956	39	82	2	80	32	46	1,368	547	787	35.9	6.00	283	196	479
1957	41	85	4	53	40	23	959	724	416	33.3	4.50	139	241	380
1958	31										4.50			

Table 48—Eggs: Production, disposition, price, and value, 1924-57

Year	Number			Season average price per doz.	Value of		Value of production1/
	Produced	Consumed on farms	Sold		Home consumption	Sales	
	1,000 doz.	1,000 doz.	1,000 doz.	Cents	1,000 dollars	1,000 dollars	1,000 dollars
1924	21,750	10,167	10,417	26.8	2,725	2,792	5,829
1925	21,417	9,833	10,500	29.6	2,911	3.108	6,339
1926	24,083	10,833	12,000	28.6	3,098	3,432	6,888
1927	24,000	11,167	11,583	25.2	2,814	2,919	6,048
1928	26,000	11,667	13,167	27.4	3,197	3,608	7,124
1929	24,917	11,000	12,667	28.2	3,102	3,572	7,026
1930	23,500	11,167	11,000	25.4	2,836	2,794	5,969
1931	22,667	11,583	9,917	17.7	2,050	1,755	4,012
1932	20,250	11,917	7,167	13.2	1,573	946	2,673
1933	20,083	11,333	7,583	13.3	1,507	1,009	2,671
1934	18,750	11,000	6,667	16.2	1,782	1,080	3,038
1935	19,667	10,333	8,333	21.2	2,191	1,767	4,169
1936	20,000	10,667	8,333	21.1	2,151	1,758	4,220
1937	22,583	11,333	10,250	20.5	2,323	2,101	4,630
1938	24,333	12,333	11,083	18.0	2,220	1,995	4,380
1939	25,917	12,083	12,917	16.8	2,030	2,170	4,354
1940	23,667	10,833	11,917	16.8	1,820	2,002	3,976
1941	25,250	10,167	14,083	21.9	2,226	3,084	5,530
1942	29,083	10,250	17,917	27.4	2,808	4,909	7,969
1943	32,500	10,750	20,667	35.3	3,795	7,295	11,473
1944	34,500	10,417	23,083	31.7	3,302	7,317	10,937

Continued

Table 48--(Continued)--Eggs: Production, disposition, price, and value, 1924-57

Year	Number			Season average price per doz.	Value of		Value of production1/
	Produced	Consumed on farms	Sold		Home Consumption	Sales	
	1,000 doz.	1,000 doz.	1,000 doz.	Cents	1,000 dollars	1,000 dollars	1,000 dollars
1945	32,500	10,250	21,250	36.7	3,762	7,799	11,561
1946	29,583	10,333	18,500	39.0	4,030	7,215	11,245
1947	28,250	10,167	17,500	46.3	4,707	8,102	12,809
1948	30,500	9,583	20,333	47.6	4,562	9,679	14,241
1949	32,917	10,000	22,333	45.6	4,560	10,184	14,744
1950	31,583	10,833	20,750	38.1	3,937	7,906	11,843
1951	31,500	9,750	21,333	48.7	4,748	10,389	15,137
1952	32,083	9,833	21,833	44.5	4,376	9,716	14,092
1953	31,833	9,917	21,917	48.4	4,679	10,608	15,407
1954	30,417	8,083	22,083	44.3	3,581	9,783	13,364
1955	30,167	8,167	21,750	43.3	3,536	9,418	12,954
1956	31,250	8,333	22,667	44.1	3,675	9,996	13,671
1957	31,750	8,250	23,333	41.9	3,457	9,777	13,234

1/Gross income plus value of eggs used for farm hatching.

Table 49--Eggs: Monthly production, January 1925-September 1958

Year	Month												Annual production
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
	Millions of eggs												
1925	10	16	32	39	36	28	25	21	16	14	10	10	257
1926	13	23	40	43	39	31	26	20	17	15	11	11	289
1927	15	26	42	41	38	30	24	20	16	15	11	10	288
1928	14	26	45	48	43	33	26	21	18	16	12	10	312
1929	15	24	41	44	38	30	26	22	19	17	13	10	299
1930	12	25	42	43	39	30	24	18	16	14	10	9	282
1931	12	22	38	41	40	33	25	17	14	12	9	9	272
1932	13	22	34	37	33	25	21	17	14	12	8	7	243
1933	11	19	34	38	34	25	20	17	13	12	9	9	241
1934	13	18	30	35	33	24	19	15	12	11	8	7	225
1935	9	17	33	38	32	24	21	16	14	13	10	9	236
1936	12	18	32	36	33	26	21	18	15	12	9	8	240
1937	12	21	36	41	39	29	23	19	17	14	10	10	271
1938	15	24	40	42	39	31	26	21	17	15	11	11	292
1939	15	24	42	45	43	35	28	22	18	15	12	12	311
1940	13	20	39	43	40	32	26	19	17	14	10	11	284
1941	16	24	40	44	40	32	27	23	19	16	11	11	303
1942	17	27	46	52	47	37	29	24	21	19	15	15	349
1943	19	31	52	55	52	41	35	30	24	20	16	15	390
1944	19	34	56	59	55	44	37	31	26	22	16	15	414
1945	20	32	50	53	50	41	36	30	25	21	16	16	390
1946	21	32	50	50	45	35	28	23	20	19	16	16	355
1947	19	27	43	45	42	34	30	25	22	20	17	15	339
1948	17	25	43	49	47	37	31	29	26	24	19	19	366
1949	25	33	49	49	45	37	33	30	28	25	20	21	395
1950	27	35	48	48	45	36	31	29	26	25	21	20	391
1951	25	33	47	47	46	37	32	29	27	27	23	23	396
1952	30	35	45	45	43	36	31	28	26	26	22	22	389
1953	25	30	42	42	40	34	29	27	26	26	23	23	367
1954	26	31	41	41	39	31	29	27	25	26	24	25	365
1955	27	29	40	38	37	33	31	28	26	25	23	25	362
1956	28	32	40	39	37	32	31	30	27	28	25	26	375
1957	29	31	41	41	39	33	31	29	28	28	25	26	381
1958	27	28	37	38	37	32	30	29	28				

Table 50—Honey bees: Number of colonies, production, price, and value of honey and beeswax, 1937-58

Year	Colonies of bees	Production		Season average price		Value of production	
		Honey	Beeswax	All honey	Beeswax	Honey	Beeswax
	1,000	1,000 pounds	1,000 pounds	Cents per pound	Cents per pound	1,000 dollars	1,000 dollars
1939	57	1,254	—	--	—	—	—
1940	60	1,020	—	--	--	--	--
1941	52	1,300	24	--	29.0	--	--
1942	56	1,008	19	10.5	40.3	106	8
1943	62	1,860	32	13.4	42.8	249	14
1944	68	1,564	42	16.0	42.0	250	18
1945	75	1,575	39	16.8	40.0	265	16
1946	81	1,215	30	17.5	46.0	213	14
1947	87	1,914	42	16.8	45.0	322	19
1948	96	1,920	40	13.1	44.0	252	18
1949	101	2,020	32	13.2	40.0	267	13
1950	96	1,920	38	12.9	43.0	248	16
1951	95	2,375	45	13.3	50.0	316	22
1952	95	2,375	45	14.6	43.0	347	19
1953	100	2,200	37	15.5	40.5	341	15
1954	93	2,418	48	16.3	41.7	394	20
1955	93	2,046	33	17.5	48.5	358	16
1956	91	2,548	46	17.7	52.2	451	24
1957	92	2,116	40	18.8	60.0	398	24
1958	88	2,376					

Table 51—Package bees: Colonies for production of package bees, package bees shipped, and queen bees shipped, 1944-51[1]

Year	Colonies held for production of package bees	Total lbs. of package bees shipped	Queen bees shipped
	Number	Pounds	Number
1944	—	178,000	177,000
1945	27,600	196,000	170,800
1946	31,700	206,000	170,000
1947	33,300	243,000	188,700
1948	33,300	216,000	141,500
1949	30,000	136,000	134,400
1950	29,000	122,400	127,700
1951	29,000	128,500	128,500

[1] This series discontinued in 1951.

Table 52--Cotton lint: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume	Season average price per pound	Farm value
	In cultivation, July 1	Harvested		Production, 500 lb. bales[1]		
	1,000 acres	1,000 acres	Pounds	1,000	Cents	1,000 dollars
1909	1,012	931	130	253	13.38	16,953
1910	930	870	135	246	14.00	17,195
1911	959	938	196	385	9.63	18,518
1912	946	922	195	376	11.38	21,400
1913	1,140	1,117	190	444	12.23	27,140
1914	1,245	1,220	176	449	7.64	17,169
1915	930	916	178	341	10.94	18,656
1916	1,136	1,127	188	443	16.82	37,272
1917	1,258	1,252	244	639	26.39	84,280
1918	1,456	1,441	195	588	28.54	83,867
1919	1,387	1,304	109	298	35.78	53,255
1920	1,303	1,243	149	388	16.80	32,564
1921	1,043	1,009	132	279	15.85	22,099
1922	1,075	1,032	159	343	22.50	38,618
1923	1,307	1,255	140	368	27.70	50,952
1924	1,456	1,427	165	493	22.05	54,315
1925	1,750	1,727	252	910	19.28	87,769
1926	1,829	1,802	220	829	12.47	51,714
1927	1,493	1,448	181	548	19.94	54,638
1928	1,873	1,836	180	691	17.77	61,392
1929	1,954	1,934	200	809	16.45	66,526
1930	1,983	1,953	175	715	9.33	33,333
1931	1,834	1,825	236	900	5.57	25,063
1932	1,702	1,668	173	611	6.74	20,574
1933	1,767	1,295	176	477	10.24	24,404
1934	1,201	1,189	195	485	12.46	30,195

Continued

Table 52--(Continued)--Cotton lint: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume	Season average price per pound	Farm value
	In cultivation, July 1	Harvested		Production, 500 lb. bales1/		
	1,000 acres	1,000 acres	Pounds	1,000	Cents	1,000 dollars
1935	1,278	1,268	210	556	10.97	30,512
1936	1,409	1,401	260	761	12.44	47,343
1937	1,575	1,569	337	1,104	8.40	46,352
1938	1,140	1,119	289	676	8.55	28,904
1939	1,154	1,120	319	745	9.02	33,584
1940	1,199	1,130	194	456	9.70	22,093
1941	1,071	1,014	148	313	17.19	26,886
1942	1,028	1,001	285	593	18.76	55,602
1943	987	982	362	739	19.54	72,172
1944	857	850	365	620	20.78	64,387
1945	764	750	248	387	22.60	43,698
1946	729	700	169	247	33.16	40,949
1947	777	770	314	505	32.43	81,782
1948	896	890	408	756	31.24	118,013
1949	974	950	329	650	29.35	95,458
1950	739	715	287	426	40.26	85,757
1951	949	935	391	760	37.10	140,903
1952	899	890	408	756	36.56	138,172
1953	967	950	407	806	33.12	133,437
1954	698	688	399	572	33.88	96,944
1955	626	615	454	582	32.70	95,169
1956	586	562	496	581	32.01	93,039
1957	461	440	380	348	32.00	59,200
1958	375		378	295		

1/500 pounds of lint cotton - gross weight.

Table 53--Cottonseed: Acreage, yield, production, price, and value, 1909-57

Year beginning August 1	Acres		Yield per acre	Production	Total sales	Season average price per ton	Farm value	Income from sales
	Used for planting1/	Harvested						
	1,000 tons	1,000 acres	Pounds	1,000 tons	1,000 tons	Dollars	1,000 dollars	1,000 dollars
1909	18	931	241	112	85	22.70	2,542	1,930
1910	18	870	251	109	80	25.64	2,795	2,051
1911	18	933	365	171	125	18.03	3,083	2,254
1912	22	922	362	167	132	18.79	3,138	2,480
1913	24	1,117	353	197	160	18.74	3,692	2,998
1914	18	1,220	326	199	175	15.26	3,037	2,670
1915	22	916	330	151	125	27.26	4,116	3,408
1916	24	1,127	350	197	170	42.83	8,438	7,281
1917	28	1,252	454	284	250	60.94	17,307	15,235
1918	27	1,441	362	261	230	64.69	16,884	14,879
1919	25	1,304	202	132	100	64.48	8,511	6,448
1920	20	1,243	277	172	125	29.07	5,000	3,634
1921	21	1,009	246	124	100	27.39	3,396	2,739
1922	25	1,032	295	152	120	28.12	4,274	3,374
1923	28	1,255	260	163	125	40.35	6,577	5,044
1924	34	1,427	307	219	175	31.18	6,823	5,456
1925	35	1,727	468	404	351	30.68	12,395	10,769
1926	29	1,802	408	368	324	21.25	7,820	6,885
1927	36	1,448	336	243	197	32.77	7,963	6,456
19282/	38	1,836	355	326	275	31.76	10,354	8,734
1929	38	1,934	389	376	300	29.60	11,130	8,880
1930	35	1,953	338	330	255	21.28	7,022	5,426
1931	33	1,825	456	416	320	7.67	3,191	2,454
1932	34	1,688	344	290	230	10.11	2,932	2,325
1933	23	1,295	344	223	180	12.20	2,721	2,196
1934	24	1,189	378	225	195	31.78	7,150	6,197

Continued

Table 53—(Continued)—Cottonseed: Acreage, yield, production, price, and value, 1909-57

Year beginning August 1	Acres		Yield per acre	Production	Total sales	Season average price per ton	Farm value	Income from sales
	Used for planting1/	Harvested						
	1,000 tons	1,000 acres	Pounds	1,000 tons	1,000 tons	Dollars	1,000 dollars	1,000 dollars
1935	27	1,268	396	251	210	30.35	7,618	6,374
1936	30	1,401	498	349	285	33.77	11,786	9,624
1937	22	1,569	579	454	380	18.79	8,531	7,140
1938	22	1,119	497	278	235	20.58	5,721	4,836
1939	23	1,120	543	304	265	19.24	5,849	5,099
1940	21	1,130	338	191	163	20.32	3,881	3,312
1941	20	1,014	266	135	115	47.54	6,418	5,467
1942	19	1,001	486	243	220	44.44	10,799	9,777
1943	15.8	982	609	299	260	51.60	15,428	13,416
1944	12.8	850	588	250	225	50.20	12,550	11,295
1945	11.7	750	435	163	140	49.80	8,117	6,673
1946	12.4	700	294	103	85	61.90	6,376	5,262
1947	13.4	770	522	201	175	79.80	16,040	13,965
1948	14.6	890	679	302	275	66.70	20,143	18,342
1949	13.3	950	556	264	240	42.10	11,114	10,104
1950	16.6	715	473	169	140	79.30	13,402	11,102
1951	16.2	935	659	308	280	64.10	19,743	17,948
1952	20.3	890	667	297	270	67.50	20,048	18,225
1953	15.7	950	699	332	315	52.80	17,530	16,632
1954	10.3	688	686	236	220	59.30	13,995	13,046
1955	9.9	615	774	238	225	42.90	10,210	9,652
1956	9.3	562	847	238	225	51.30	12,209	11,542
1957	7.3	440	677	151	140	47.60	7,188	6,678

1/ Used for planting succeeding year.

2/ Prior to 1928 cottonseed was computed on the basis of 65 pounds of seed to 35 pounds of lint.

Table 54—Rice: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
	Planted	Harvested		Production	Sold			
	1,000 acres	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1909	--	370	15.3	5,678	5,037	1.71	9,715	8,619
1910	--	360	16.6	5,994	5,363	1.44	8,658	7,747
1911	--	350	15.1	5,276	4,652	1.73	9,146	8,064
1912	--	315	16.0	5,032	4,374	1.96	9,840	8,554
1913	--	350	14.4	5,040	4,427	1.93	9,744	8,558
1914	--	320	16.2	5,184	4,524	1.98	10,253	8,947
1915	--	385	15.1	5,804	5,094	1.80	10,447	9,168
1916	--	435	20.7	9,004	8,230	2.11	19,010	17,376
1917	--	485	14.8	7,202	6,334	4.20	30,249	26,604
1918	--	565	14.4	8,136	7,279	3.84	31,278	27,983
1919	--	543	15.8	8,552	7,576	5.53	47,322	41,922
1920	--	676	16.6	11,255	10,421	2.51	28,264	26,169
1921	--	549	15.2	8,325	7,502	2.13	17,761	16,004
1922	--	555	15.7	8,691	7,952	2.11	18,348	16,786
1923	--	474	15.1	7,146	6,458	2.42	17,308	15,643
1924	--	430	15.8	6,772	6,107	2.93	19,866	17,914
1925	--	414	15.4	6,372	5,634	3.31	21,097	18,656
1926	--	492	14.8	7,306	6,548	2.47	18,022	16,153
1927	--	520	17.1	8,915	8,184	2.04	18,227	16,732
1928	--	495	17.1	8,487	7,773	2.09	17,728	16,237
1929	--	465	18.2	8,474	7,722	2.22	18,832	17,161
1930	--	491	17.6	8,617	7,884	1.71	14,745	13,491
1931	--	458	15.8	7,214	6,534	1.16	8,336	7,551
1932	--	415	17.8	7,376	6,691	.96	7,049	6,394
1933	--	395	18.4	7,288	6,582	1.73	12,632	11,409
1934	--	415	18.2	7,545	6,845	1.82	13,748	12,474

Continued

Table 54--(Continued)--Rice: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
	Planted	Harvested		Production	Sold			
	1,000 acres	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1935	—	412	18.9	7,783	7,015	1.58	12,280	11,068
1936	—	479	19.8	9,484	8,685	2.00	18,968	17,370
1937	—	517	18.0	9,306	8,510	1.53	14,269	13,049
1938	—	494	18.9	9,337	8,544	1.44	13,486	12,341
1939	—	485	19.8	9,603	8,798	1.64	15,792	14,467
1940	—	469	18.0	8,442	7,578	1.89	15,946	14,313
1941	—	544	16.9	9,180	8,292	2.96	27,132	24,444
1942	—	615	17.1	10,516	9,588	3.60	37,859	34,517
1943	—	603	16.2	9,769	8,861	4.02	39,291	35,643
1944	—	561	17.1	9,593	8,699	3.98	38,159	34,602
1945	—	584	17.8	10,363	9,444	4.07	42,141	38,404
1946	—	589	17.3	10,204	9,346	5.13	52,382	47,976
1947	—	613	16.2	9,931	9,011	4.89	61,748	51,662
1948	—	631	17.8	11,216	10,225	4.87	54,584	49,761
1949	599	593	18.3	10,822	9,865	4.38	47,292	45,465
1950	569	563	19.5	10,969	10,545	5.07	55,658	53,985
1951	632	619	19.5	12,070	11,540	4.56	54,918	53,449
1952	605	600	20.2	12,150	11,713	5.52	67,190	65,365
1953	620	612	20.7	12,699	11,833	5.01	63,662	61,623
1954	682	679	23.5	15,956	15,652	4.26	67,973	66,678
1955	530	526	28.0	14,728	14,427	4.66	68,632	67,230
1956	456	450	27.0	12,150	11,411	4.80	58,320	54,202
1957	418	400	26.5	10,600	10,410	5.20	55,120	54,132
1958	418	412	28.0	11,536				

Table 55--Sugar cane (for sugar and seed): Acreage, yield, production, price, and value, 1909-58

Year	Acres harvested			Yield per acre	Production	Sold	Season average price per ton	Farm value	Income from sales
	For Sugar	For seed	Total						
	1,000 acres	1,000 acres	1,000 acres	Tons	1,000 tons	1,000 tons	Dollars	1,000 dollars	1,000 dollars
1909	282	31	313	15.0	4,698	4,229	3.83	17,993	16,197
1910	300	26	326	17.0	5,537	5,046	3.69	20,432	18,620
1911	310	26	336	19.0	6,375	5,887	4.29	37,349	25,255
1912	197	58	255	11.0	2,807	2,163	3.73	10,470	8,068
1913	248	36	284	17.0	4,834	4,214	3.13	15,130	13,190
1914	213	37	250	15.0	3,758	3,199	3.75	14,092	11,996
1915	183	55	238	11.0	2,623	2,018	4.55	11,935	9,182
1916	221	38	259	18.3	4,749	4,072	5.29	25,122	21,541
1917	244	41	285	15.7	4,465	3,813	7.10	31,702	27,072
1918	231	32	263	18.0	4,738	4,170	7.28	34,493	30,358
1919	179	54	233	10.5	2,455	1,883	14.00	34,370	26,362
1920	183	64	247	13.6	3,361	2,493	5.76	19,359	14,360
1921	226	46	272	18.5	5,033	4,181	3.63	18,270	15,177
1922	242	53	295	15.6	4,600	3,778	5.83	26,818	22,026
1923	215	71	286	11.1	3,171	2,387	7.09	22,482	16,924
1924	163	88	251	7.6	1,900	1,228	5.58	10,602	6,852
1925	190	46	236	14.0	3,293	2,644	4.05	13,337	10,708
1926	128	33	161	6.8	1,088	864	4.92	5,353	4,251
1927	73	16	89	13.1	1,168	962	4.61	5,384	4,435
1928	130	16	146	14.4	2,099	1,860	3.86	8,102	7,180
1929	185	13	198	15.9	3,140	2,918	3.77	11,838	11,001
1930	175	16	191	14.6	2,793	2,559	3.38	9,440	8,649
1931	169	17	186	13.2	2,463	2,232	3.29	8,103	7,343
1932	208	21	229	13.8	3,167	2,886	3.06	9,691	8,831
1933	197	22	219	13.2	2,892	2,600	3.29	9,515	8,554
1934	222	25	247	14.3	3,522	3,164	2.33	8,026	7,372
1935	239	22	261	17.5	4,568	4,183	3.18	14,526	13,302
1936	227	20	247	21.4	5,282	4,854	3.71	19,596	18,008
1937	266	19	285	19.7	5,615	5,241	2.91	16,340	15,251
1938	272	19	291	21.5	6,267	5,859	2.66	16,670	15,585
1939	234	21	255	21.7	5,540	5,084	2.88	15,955	14,642
1940	211	31	242	13.9	3,354	2,923	2.72	9,123	7,951
1941	224	31	255	17.6	4,493	3,947	3.94	17,702	15,551
1942	269	25	294	17.6	5,174	4,734	4.35	22,507	20,593
1943	257	19	276	21.0	5,787	5,388	4.60	26,620	24,785
1944	246	20	266	20.0	5,329	4,929	4.98	26,538	24,546
1945	234	19	253	22.3	5,633	5,209	5.58	31,432	29,066
1946	255	23	278	17.6	4,889	4,484	6.55	31,974	29,370
1947	259	27	286	15.1	4,325	3,917	7.24	31,313	28,359
1948	274	24	298	19.2	5,718	5,257	5.88	33,622	30,911
1949	279	22	301	17.9	5,378	4,984	6.20	33,344	30,901
1950	273	22	295	19.5	5,741	5,312	7.88	45,239	41,859
1951	258	21	279	17.3	4,826	4,463	5.87	28,329	26,198
1952	275	20	295	20.6	6,079	5,667	6.64	40,365	37,629
1953	280	19	299	20.6	6,150	5,759	7.10	43,665	40,889
1954	247	19	266	22.8	6,058	5,625	6.71	40,649	37,744
1955	232	16	248	24.4	6,051	5,661	6.26	37,879	35,438
1956	204	18	222	23.6	5,242	4,817	7.87	41,255	37,910
1957	226	17	243	22.0	5,350	4,976	6.69	33,289	39,028
1958			248	23.5	5,828				

Table 56—Sugar cane (for sugar): Acreage, yield, production, price, and value, 1909-57

Year	Acreage harvested	Yield per acre	Production	Season average price per ton 1/	Farm value
	1,000 acres	Tons	1,000 tons	Dollars	1,000 dollars
1909	282	15.0	4,229	3.83	16,197
1910	300	16.8	5,046	3.69	18,620
1911	310	19.0	5,887	4.29	25,255
1912	197	11.0	2,163	3.73	8,068
1913	248	17.0	4,214	3.13	13,190
1914	213	15.0	3,199	3.75	11,996
1915	183	11.0	2,018	4.55	9,182
1916	221	18.4	4,072	5.29	21,541
1917	244	15.6	3,813	7.10	27,072
1918	231	18.1	4,170	7.28	30,358
1919	179	10.5	1,883	14.00	26,362
1920	183	13.6	2,493	5.76	14,360
1921	226	18.5	4,181	3.63	15,177
1922	242	15.6	3,778	5.83	22,026
1923	215	11.1	2,387	7.09	16,924
1924	163	7.5	1,228	5.58	6,852
1925	190	13.9	2,644	4.05	10,708
1926	128	6.8	864	4.92	4,251
1927	73	13.2	962	4.61	4,435
1928	130	14.3	1,860	3.86	7,180
1929	185	15.8	2,918	3.77	11,001
1930	175	14.6	2,559	3.38	8,649
1931	169	13.2	2,232	3.29	7,343
1932	208	13.9	2,886	3.06	8,831
1933	197	13.2	2,600	3.29	8,554
1934	222	14.3	3,164	2.33	7,034
1935	239	17.5	4,183	3.18	12,997
1936	227	21.4	4,854	3.71	18,008
1937	266	19.7	5,241	2.91	15,269
1938	272	21.5	5,859	2.66	15,585
1939	234	21.7	5,084	2.88	14,599
1940	211	13.9	2,923	2.72	7,790
1941	224	17.6	3,947	3.94	15,516
1942	269	17.6	4,752	4.35	20,671
1943	257	21.0	5,388	4.60	24,780
1944	246	20.0	4,929	4.98	24,546
1945	234	22.3	5,209	5.58	29,066
1946	255	17.6	4,484	6.55	29,370
1947	259	15.1	3,917	7.24	28,359
1948	274	19.2	5,257	5.88	30,911
1949	279	17.9	4,984	6.20	30,901
1950	273	19.5	5,312	7.88	41,859
1951	258	17.3	4,463	5.87	26,198
1952	275	20.6	5,667	6.64	37,629
1953	280	20.6	5,759	7.10	40,889
1954	247	22.8	5,625	6.71	37,744
1955	232	24.4	5,661	6.26	35,438
1956	204	23.6	4,817	7.87	37,910
1957	226	22.0	4,972	6.69	39,028

1/Does not include benefit payments.

Table 57—Sugar cane (for sirup): Acreage, yield, production, price, and value, 1909-57

Year	Acreage harvested	Yield per acre	Volume			Season average price per gallon	Farm value	Income from sales
			Production	Used on farm where produced	Sold			
	1,000 acres	Gallons	1,000 gallons	1,000 gallons	1,000 gallons	Cents	1,000 dollars	1,000 dollars
1909	17.7	233	4,125	529	3,596	40	1,650	1,438
1910	25.0	260	6,512	1,426	5,086	44	2,865	2,238
1911	32.5	229	7,443	1,693	5,750	44	3,275	2,530
1912	39.0	215	8,400	1,910	6,490	41	3,444	2,661
1913	38.0	217	8,260	1,879	6,381	43	3,552	2,744
1914	29.0	240	6,950	1,581	5,369	43	2,988	2,309
1915	30.0	244	7,310	1,615	5,695	48	3,509	2,734
1916	38.0	218	8,266	1,447	6,819	55	4,546	3,750
1917	45.8	222	10,159	1,451	8,708	59	5,994	5,138
1918	65.8	227	14,959	1,315	13,644	68	10,172	9,278
1919	22.0	183	4,020	546	3,474	107	4,301	3,717
1920	19.0	244	4,634	953	3,681	96	4,449	3,534
1921	19.0	335	6,357	1,240	5,117	54	3,433	2,763
1922	23.0	282	6,485	1,313	5,172	49	3,178	2,534
1923	29.0	232	6,720	1,177	5,543	59	3,965	3,270
1924	52.0	194	10,068	306	9,762	43	4,329	4,198
1925	25.0	262	6,541	203	6,338	35	2,289	2,218
1926	34.0	133	4,516	285	4,231	41	1,852	1,735
1927	15.0	319	4,787	414	4,373	44	2,106	1,924
1928	23.0	290	6,679	496	6,183	37	2,471	2,288
1929	20.0	289	5,773	601	5,172	41	2,367	2,121
1930	26.0	239	6,208	451	5,757	36	2,235	2,073
1931	21.0	216	4,545	700	3,845	39	1,773	1,500
1932	19.0	192	3,650	676	2,974	34	1,241	1,011
1933	24.0	227	5,458	840	4,618	33	1,801	1,524
1934	27.0	233	6,291	947	6,054	37	2,328	2,240

Continued

Table 57--(Continued)--Sugar cane (for sirup): Acreage, yield, production, price, and value, 1909-57

Year	Acreage harvested	Yield per acre	Volume			Season average price per gallon	Farm value	Income from sales
			Production	Used on farm where produced	Sold			
	1,000 acres	Gallons	1,000 gallons	1,000 gallons	1,000 gallons	Cents	1,000 dollars	1,000 dollars
1935	25.0	256	6,400	1,359	5,557	40	2,560	2,223
1936	24.0	285	6,840	1,277	6,133	36	2,462	2,208
1937	26.0	283	7,358	1,947	6,263	41	3,017	2,568
1938	26.0	255	6,630	1,578	5,817	38	2,519	2,210
1939	29.0	291	8,439	1,525	6,914	35	2,954	2,420
1940	26.0	220	5,720	1,169	4,551	40	2,288	1,820
1941	24.0	260	6,240	1,374	4,866	56	3,494	2,725
1942	24.0	240	5,760	1,000	4,760	62	3,571	2,951
1943	29.0	275	7,975	1,276	6,699	74	5,902	4,957
1944	29.0	230	6,670	1,134	5,536	66	4,402	3,654
1945	45.0	335	15,075	1,800	13,275	74	11,156	9,824
1946	43.0	275	11,825	1,182	10,643	120	14,190	12,772
1947	36.0	235	8,460	846	7,614	80	6,768	6,091
1948	11.0	200	2,200	668	1,532	80	1,760	1,226
1949	11.0	250	2,750	330	2,420	70	1,925	1,694
1950	12.0	330	3,960	228	3,672	80	3,168	2,938
1951	9.0	320	2,880	220	2,660	85	2,448	2,261
1952	8.0	410	3,280	165	3,165	94	3,083	2,928
1953	5.0	445	2,225	138	2,087	93	2,069	1,941
1954	8.0	375	3,000	75	2,925	87	2,610	2,545
1955	7.0	450	3,150	88	3,160	87	2,740	2,751
1956	7.0	325	2,275	75	2,200	83	1,888	1,826
1957	4.0	435	1,740	75	1,665	89	1,549	1,432

Table 58--Corn: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per bushel	Farm value	Income from sales
	planted	harvested		Production	Sold			
	1,000 acres	1,000 acres	Bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1909	-	1,592	16.4	26,109	2,341	.74	19,321	1,732
1910	-	1,700	18.0	30,600	3,900	.62	18,972	2,418
1911	-	1,700	15.0	25,500	2,000	.76	19,380	1,520
1912	-	1,560	16.0	24,960	735	.73	18,221	537
1913	-	1,600	17.0	27,200	2,140	.82	22,304	1,755
1914	-	1,620	15.5	25,110	2,460	.87	21,846	2,140
1915	-	1,660	17.0	28,220	2,085	.72	20,318	1,501
1916	-	1,560	17.0	26,520	1,813	1.13	29,968	2,049
1917	-	1,600	14.5	23,200	1,462	1.62	37,584	2,368
1918	-	1,600	13.0	20,800	1,020	1.72	35,776	1,754
1919	-	1,523	14.5	22,084	655	1.73	38,205	1,133
1920	-	1,462	18.0	26,316	1,040	.99	26,053	1,030
1921	-	1,580	17.5	27,650	955	.72	19,908	688
1922	-	1,375	16.0	22,000	850	.94	20,680	799
1923	-	1,278	14.0	17,892	1,022	1.09	19,502	1,114
1924	-	1,250	11.0	13,750	657	1.22	16,775	802
1925	-	1,225	16.0	19,600	966	1.01	19,796	976
1926	1,127	1,127	15.5	17,468	858	.90	15,721	772
1927	1,161	1,161	16.0	18,576	912	.99	18,390	903
1928	1,242	1,242	15.0	18,630	910	.98	18,257	892
1929	1,212	1,190	15.8	18,802	924	.95	17,862	878
1930	1,261	1,190	11.0	13,090	634	.89	11,650	564
1931	1,400	1,368	16.0	21,888	1,284	.44	9,631	565
1932	1,540	1,505	14.2	21,371	1,051	.44	9,403	462
1933	1,478	1,429	13.0	18,577	951	.63	11,704	576
1934	1,655	1,596	9.6	15,322	743	.91	13,943	676

Table 58--(Continued)—Corn: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per bushel	Farm value	Income from sales
	Planted	Harvested		Production	Sold			
	1,000 acres	1,000 acres	Bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1935	1,688	1,628	16.0	26,048	1,932	.71	18,494	1,372
1936	1,620	1,547	13.5	20,884	926	.96	20,049	889
1937	1,507	1,485	17.5	25,988	1,929	.66	17,152	1,273
1938	1,733	1,693	16.5	27,934	2,760	.52	14,526	1,435
1939	1,733	1,647	14.0	23,058	1,133	.64	14,757	725
1940	1,594	1,548	15.0	23,220	1,476	.65	15,093	959
1941	1,482	1,440	14.0	20,160	1,281	.83	16,733	1,063
1942	1,334	1,296	17.0	22,032	1,511	.99	21,812	1,496
1943	1,307	1,270	16.0	20,320	1,093	1.35	27,432	1,476
1944	1,229	1,168	14.0	16,352	877	1.39	22,729	1,219
1945	1,106	1,075	18.5	19,888	1,273	1.39	27,644	1,769
1946	1,040	1,000	14.0	14,000	887	1.79	25,060	1,588
1947	990	960	13.5	12,960	762	2.20	28,512	1,676
1948	955	902	17.5	15,785	990	1.58	24,940	1,564
1949	790	758	19.5	14,781	1,163	1.30	19,215	1,512
1950	853	834	19.5	16,263	1,552	1.46	23,744	2,266
1951	725	709	21.5	15,244	1,612	1.65	25,153	2,660
1952	703	666	18.5	12,321	2,028	1.79	22,055	3,630
1953	605	559	18.5	10,342	1,520	1.56	16,134	2,371
1954	647	626	19.0	11,894	2,415	1.43	17,008	3,453
1955	647	639	29.5	18,850	1,435	1.06	19,981	1,578
1956	634	626	26.5	16,589	1,351	1.24	20,570	1,675
1957	628	588	23.0	13,524	2,651	1.30	17,581	3,446
1958	590	582	29.0	16,878				

Table 59--Corn: Production, farm disposition, and value, 1909-58

Year	Production	Used on farms where grown		Sold	Season average price per bushel2/	Value of		
		Feed and seed1/	Home use			Production	Home use	Sales
	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars	1,000 dollars
1909	26,109	23,268	500	2,341	.74	19,321	370	1,732
1910	30,600	26,150	550	3,900	.62	18,972	341	2,418
1911	25,500	22,940	560	2,000	.76	19,380	426	1,520
1912	24,960	23,695	530	735	.73	18,221	387	537
1913	27,200	24,510	550	2,140	.82	22,304	451	1,755
1914	25,110	22,070	580	2,460	.87	21,846	505	2,140
1915	28,220	25,535	600	2,085	.72	20,318	432	1,501
1916	26,520	24,127	580	1,813	1.13	29,968	655	2,049
1917	23,200	21,128	610	1,462	1.62	37,584	988	2,368
1918	20,800	19,160	620	1,020	1.72	35,776	1,066	1,754
1919	22,084	20,829	600	655	1.73	38,205	1,038	1,133
1920	26,316	24,706	570	1,040	.99	26,053	564	1,030
1921	27,650	26,075	620	955	.72	19,908	446	688
1922	22,000	20,630	520	850	.94	20,680	489	799
1923	17,892	16,390	480	1,022	1.09	19,502	523	1,114
1924	13,750	12,623	470	657	1.22	16,775	573	802
1925	19,600	18,144	490	966	1.01	19,796	495	976
1926	17,468	16,130	480	858	.90	15,721	432	772
1927	18,576	17,144	520	912	.99	18,390	515	903
1928	18,630	17,130	590	910	.98	18,257	578	892
1929	18,802	17,268	610	924	.95	17,862	580	878
1930	13,090	11,866	590	634	.89	11,650	525	564
1931	21,888	19,944	660	1,284	.44	9,631	290	565
1932	21,371	19,595	725	1,051	.44	9,403	319	462
1933	18,577	16,962	700	915	.63	11,704	441	576
1934	15,322	13,849	730	743	.91	13,943	664	676
1935	26,048	23,401	715	1,932	.71	18,494	508	1,372
1936	20,884	19,315	643	926	.96	20,049	617	889
1937	25,988	23,452	607	1,929	.66	17,152	401	1,273
1938	27,934	24,576	598	2,760	.52	14,526	311	1,435
1939	23,058	21,387	538	1,133	.64	14,757	344	725
1940	23,220	21,236	508	1,476	.65	15,093	330	959
1941	20,160	18,419	460	1,281	.83	16,733	382	1,063
1942	22,032	20,101	420	1,511	.99	21,812	416	1,496
1943	20,320	18,827	400	1,093	1.35	27,432	540	1,476
1944	16,352	15,105	370	877	1.39	22,729	514	1,219
1945	19,888	19,276	344	1,273	1.39	27,644	478	1,769
1946	14,000	13,769	280	887	1.79	25,060	496	1,588
1947	12,960	12,831	270	762	2.20	28,512	594	1,676
1948	15,785	15,141	262	990	1.58	24,940	419	1,564
1949	14,781	13,393	225	1,163	1.30	19,215	292	1,512
1950	16,263	14,501	210	1,552	1.46	23,744	307	2,266
1951	15,244	13,447	185	1,612	1.65	25,153	305	2,660
1952	12,321	10,139	154	2,028	1.79	22,055	276	3,630
1953	10,342	8,701	121	1,520	1.56	16,134	189	2,371
1954	11,894	9,365	114	2,415	1.43	17,008	163	3,453
1955	18,850	13,807	104	1,435	1.06	19,981	110	1,578
1956	16,589	13,728	91	1,351	1.24	20,570	113	1,675
1957	13,524	10,795	78	2,651	1.30	17,581	101	3,446
1958	16,878							

1/Includes grain equivalent of corn silage and forage as well as grain corn.

2/Includes an allowance for unredeemed loan and purchase agreement deliveries valued at the average loan rate.

Table 60--Corn: Acreage planted with hybrid seed, 1938-58

Year	All corn (Planted acreage)	Percentage planted with hybrid seed	Indicated hybrid corn acreage
	1,000 acres	per cent	1,000 acres
1938	1,733	1/	---
1939	1,733	.2	4
1940	1,594	.4	6
1941	1,482	1.1	16
1942	1,334	1.5	23
1943	1,307	2.1	27
1944	1,229	3.7	45
1945	1,106	4.8	53
1946	1,040	8.0	83
1947	990	15.0	148
1948	955	17.5	167
1949	790	23.5	186
1950	853	30.5	260
1951	725	35.0	254
1952	703	39.5	278
1953	605	42.5	257
1954	647	47.0	304
1955	647	48.0	311
1956	634	51.5	327
1957	628	61.5	382
1958	609		

1/ Less than one-tenth of one percent.

Table 61--Oats: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume			Season average price per bushel	Farm value	Income from sales
	Planted	Harvested		Production	Used for feed and seed on farm where grown	Sold			
	1,000 acres	1,000 acres	Bushels	1,000 bushels	1,000 bushels	1,000 bushels	Cents	1,000 dollars	1,000 dollars
1909	-	30	17.0	510	484	26	65	332	17
1910	-	35	21.0	735	706	29	56	412	16
1911	-	36	16.0	576	547	29	62	357	18
1912	-	30	19.0	570	542	28	59	336	17
1913	-	36	20.0	720	677	43	56	403	24
1914	-	40	23.0	920	846	74	62	570	46
1915	-	60	21.0	1,260	1,071	189	64	806	121
1916	-	56	18.5	1,036	912	124	61	632	76
1917	-	52	19.0	988	909	79	90	889	71
1918	-	51	21.5	1,096	1,030	66	105	1,151	69
1919	-	50	20.0	1,000	960	40	105	1,050	42
1920	-	35	23.0	805	765	40	109	877	44
1921	-	27	23.0	621	584	37	62	385	23
1922	-	24	23.5	564	530	34	61	344	21
1923	-	25	19.0	475	451	24	66	314	16
1924	-	17	19.0	323	307	16	70	226	11
1925	-	14	21.5	301	283	18	69	208	12
1926	12	12	28.0	336	316	20	61	205	12
1927	11	11	16.5	182	173	9	64	116	6
1928	15	15	26.0	390	378	12	72	281	9
1929	17	15	25.5	382	371	11	68	260	7
1930	17	14	24.0	336	319	17	57	192	10
1931	34	31	29.0	899	845	54	37	333	20
1932	31	25	16.0	400	388	12	30	120	4
1933	26	22	16.5	363	352	11	45	163	5
1934	36	32	24.0	768	714	54	62	476	33

Continued

Table 61--(Continued)--Oats: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume			Season average price per bushel	Farm value	Income from sales
	Planted	Harvested		Production	Used for feed and seed on farm where grown	Sold			
	1,000 acres	1,000 acres	Bushels	1,000 bushels	1,000 bushels	1,000 bushels	Cents	1,000 dollars	1,000 dollars
1935	65	57	22.5	1,282	1,154	128	49	628	63
1936	54	46	28.0	1,288	1,185	103	54	696	56
1937	57	52	33.0	1,716	1,544	172	51	875	88
1938	64	57	27.0	1,539	1,324	215	37	569	80
1939	67	60	32.0	1,920	1,651	269	40	768	108
1940	87	78	32.5	2,535	2,256	279	42	1,065	117
1941	96	86	29.5	2,537	2,221	555	47	1,192	261
1942	119	100	29.0	3,150	2,488	662	58	1,827	353
1943	156	132	28.0	4,060	3,370	690	88	3,573	553
1944	200	152	29.0	4,408	3,615	793	98	4,320	777
1945	198	131	28.0	3,668	2,788	880	85	3,118	748
1946	136	100	22.0	2,200	1,826	374	116	2,552	434
1947	145	100	26.0	2,600	2,080	520	114	2,964	593
1948	113	80	30.0	2,400	1,896	504	106	2,544	534
1949	113	60	25.5	1,530	1,178	352	90	1,377	317
1950	100	45	22.0	990	812	178	99	980	176
1951	93	43	26.0	1,118	939	179	108	1,207	193
1952	116	48	32.0	1,536	1,183	353	105	1,613	371
1953	150	75	30.0	2,250	1,462	788	88	1,980	693
1954	204	110	33.0	3,630	2,541	1,089	84	3,049	915
1955	275	124	33.0	4,092	2,905	1,187	76	3,110	902
1956	234	112	31.0	3,472	2,743	729	73	2,535	532
1957	250	95	27.0	2,565	1,821	744	75	1,924	558
1958	150	66	23.0	1,518					

Table 62--Soybeans (for beans): Acreage, yield, production, price, and value, 1924-58

Year	Acreage harvested	Yield per acre	Volume		Season average price	Farm value	Income from sales
			Production	Sold			
	1,000 acres	Bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1924	8	8.0	64	42	3.33	213	140
1925	12	10.0	120	88	3.57	428	314
1926	18	8.5	153	116	2.86	438	332
1927	21	9.0	189	146	2.78	525	406
1928	17	7.5	128	89	2.99	383	266
1929	21	10.5	220	148	3.16	695	468
1930	16	10.5	168	94	2.73	459	257
1931	12	11.0	132	70	1.78	235	125
1932	10	11.0	110	50	1.34	147	67
1933	7	12.0	84	31	2.01	169	62
1934	8	11.0	88	33	2.54	224	84
1935	9	12.5	112	27	1.99	223	54
1936	20	13.0	260	165	2.15	559	355
1937	12	12.0	144	46	1.41	203	65
1938	14	12.0	168	59	1.36	228	80
1939	16	13.5	216	113	1.18	255	133
1940	15	13.5	202	59	1.46	295	86
1941	16	11.5	184	87	1.97	362	171
1942	72	12.5	900	617	1.89	1,701	1,166
1943	33	11.5	380	208	2.80	1,064	582
1944	23	12.0	276	227	2.83	781	642
1945	23	14.0	322	244	2.65	853	647
1946	26	13.0	338	249	3.01	1,017	749
1947	23	12.5	288	224	3.33	959	746
1948	33	14.0	462	384	2.64	1,220	1,014
1949	23	15.0	345	307	2.31	797	709
1950	40	18.0	720	669	2.35	1,692	1,572
1951	48	18.0	864	822	2.65	2,290	2,178
1952	50	15.0	750	715	2.75	2,062	1,966
1953	50	17.0	850	813	2.50	2,125	2,032
1954	73	17.0	1,241	1,198	2.58	3,202	3,091
1955	88	22.0	1,936	1,328	2.09	4,046	2,789
1956	135	17.0	2,295	2,192	2.15	4,934	4,713
1957	119	21.0	2,499	2,404	2.05	5,132	4,952
1958	120	26.0	3,120				

Table 63--Soybeans (for beans): Production, disposition, price, and value, 1924-58

Year	Production	Farm disposition				Season average price per bushel	Value of production	Value of sales
		Used for seed		Fed to live-stock	Sold			
		Total	On-farms where grown					
	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1924	64	32	6	16	42	3.33	213	140
1925	120	48	10	22	88	3.57	428	314
1926	153	61	12	25	116	2.86	438	332
1927	189	67	13	30	146	2.78	525	406
1928	128	84	17	22	89	2.99	383	266
1929	220	66	28	44	148	3.16	695	468
1930	168	58	24	50	94	2.73	459	257
1931	132	58	22	40	70	1.78	235	125
1932	110	60	22	38	50	1.34	147	67
1933	84	54	19	34	31	2.01	169	62
1934	88	55	20	35	33	2.54	224	84
1935	112	136	51	34	27	1.99	223	54
1936	260	154	56	39	165	2.15	559	355
1937	144	175	62	36	46	1.41	203	65
1938	168	222	67	42	59	1.36	228	80
1939	216	225	49	54	113	1.18	255	133
1940	202	297	103	40	59	1.46	295	86
1941	184	289	69	28	87	1.97	362	171
1942	900	324	211	72	617	1.89	1,701	1,166
1943	380	230	115	57	208	2.80	1,064	582
1944	276	233	35	14	227	2.83	781	642
1945	322	237	39	39	244	2.65	853	647
1946	338	235	38	51	249	3.01	1,017	749
1947	288	199	24	40	224	3.33	959	746
1948	462	153	23	55	384	2.64	1,220	1,014
1949	345	172	21	17	307	2.31	797	709
1950	720	196	29	22	669	2.35	1,692	1,572
1951	864	167	25	17	822	2.65	2,290	2,178
1952	750	142	20	15	715	2.75	2,062	1,966
1953	850	182	24	13	813	2.50	2,125	2,032
1954	1,241	182	18	25	1,198	2.58	3,202	3,091
1955	1,936	239	24	56	1,328	2.09	4,046	2,789
1956	2,295	284	57	46	2,192	2.15	4,934	4,713
1957	2,499	211	53	42	2,404	2.05	5,123	4,952
1958	3,120							

Table 64--Soybeans: Acreage for all purposes, 1924-58

Year	Grown alone	Interplanted	Equivalent solid1/	For beans	For hay	Other purposes
	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres
1924	10	70	45	8	32	5
1925	13	80	53	12	31	10
1926	26	108	80	18	44	18
1927	35	134	102	21	52	29
1928	30	164	112	17	53	42
1929	40	200	140	21	70	49
1930	34	194	131	16	76	39
1931	28	178	117	12	61	44
1932	28	174	115	10	60	45
1933	35	170	120	7	72	41
1934	27	164	109	8	57	44
1935	25	170	110	9	59	42
1936	44	454	271	20	54	197
1937	56	505	308	12	66	230
1938	78	545	350	14	84	252
1939	110	540	370	16	86	268
1940	110	530	375	15	82	278
1941	149	550	424	16	89	319
1942	155	517	413	17	70	271
1943	147	517	405	36	62	310
1944	85	403	287	23	34	230
1945	99	383	291	23	29	239
1946	104	360	284	26	34	224
1947	110	367	294	23	21	250
1948	119	330	284	33	21	230
1949	74	287	218	23	16	179
1950	96	300	246	40	14	192
1951	125	240	245	48	14	183
1952	107	204	209	50	20	139
1953	97	159	177	50	14	113
1954	134	188	228	73	16	139
1955	137	184	227	88	11	128
1956	185	184	277	135	12	130
1957	160	149	234	119	9	106
1958	170	145	242	120		

1/Acres grown alone, plus allowance for interplanted acres (usually one-half the interplanted acres).

Table 65.--Cowpeas (for peas): Acreage, yield, production, price, and value, 1924-57

Year	Acreage harvested	Yield per acre	Volume		Season average price per bushel	Farm value	Income from sales
			Production	Sold			
	1,000 acres	Bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1924	32	7.5	240	81	3.75	900	304
1925	33	9.5	314	131	3.55	1,115	465
1926	23	8.0	184	37	2.70	497	100
1927	30	10.0	300	70	2.41	723	169
1928	22	9.0	198	48	2.69	533	129
1929	25	6.0	150	22	2.82	423	62
1930	33	3.5	116	9	2.42	281	22
1931	43	4.5	194	16	1.35	262	22
1932	51	4.8	245	49	1.14	279	56
1933	54	4.0	216	26	1.61	348	42
1934	71	3.6	256	49	1.95	499	96
1935	62	4.3	267	51	1.76	470	90
1936	64	3.3	211	21	1.98	418	42
1937	64	3.2	205	25	1.64	336	41
1938	66	3.0	198	30	1.47	291	44
1939	58	4.1	238	39	1.35	321	53
1940	63	4.5	284	62	1.47	417	91
1941	65	4.0	260	67	2.03	528	136
1942	54	4.5	243	45	2.46	598	111
1943	44	5.5	242	51	3.28	794	167
1944	23	8.0	184	71	3.34	615	237
1945	18	8.0	144	37	3.45	497	128
1946	15	7.0	105	23	4.30	452	99
1947	19	8.0	152	18	4.77	725	229
1948	20	6.0	120	29	4.31	517	125
1949	17	7.5	128	45	3.54	453	159
1950	12	7.5	90	27	4.33	390	117
1951	8	8.5	68	14	4.67	318	65
1952	9	6.5	58	7	4.50	261	32
1953	9	9.0	81	15	4.45	360	67
1954	8	6.5	52	3	4.40	229	13
1955	9	10.0	90	17	3.75	338	64
1956	10	9.0	90	17	4.20	378	71
1957	6	7.0	42	6	4.40	185	26

Table 66--Cowpeas: Acreage for all purposes, 1924-57

Year	Grown alone	Interplanted	Equivalent solid[1]	For peas	For hay	Other purposes
	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres
1924	40	160	120	32	72	16
1925	40	145	113	13	65	15
1926	30	120	90	23	45	22
1927	45	150	120	30	57	33
1928	41	140	111	22	51	38
1929	28	90	73	25	29	19
1930	30	129	92	33	43	16
1931	42	150	117	43	49	15
1932	61	210	166	51	80	35
1933	63	196	161	54	64	43
1934	67	232	183	71	92	20
1935	64	200	164	62	89	13
1936	115	290	260	64	78	118
1937	116	340	286	64	70	152
1938	140	326	303	66	64	173
1939	120	323	282	58	50	174
1940	113	233	230	63	44	123
1941	147	163	229	65	38	126
1942	115	122	176	54	26	96
1943	82	104	134	44	20	70
1944	67	78	106	23	15	68
1945	64	58	93	18	8	67
1946	46	42	67	15	9	43
1947	43	39	63	19	7	37
1948	45	38	64	20	7	37
1949	48	34	65	17	6	42
1950	38	25	50	12	7	31
1951	26	17	34	8	4	22
1952	26	16	34	9	5	20
1953	28	15	36	9	4	23
1954	33	18	42	8	3	31
1955	30	18	39	9	3	27
1956	39	16	47	10	3	34
1957	29	14	36	6	-	30

---

[1] Acres grown alone plus an allowance for interplanted acres (usually one-half of the interplanted acres).

Table 67—Cowpeas (for peas): Production, disposition, price, and value, 1924-57

Year	Production	Farm disposition: Used for seed: Total	Farm disposition: Used for seed: On farms where grown	Farm disposition: Fed to livestock	Farm disposition: For farm household use	Farm disposition: Sold	Season average price per bushel	Value of production	Value of home consumption	Value of sales
	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars	1,000 dollars
1924	240	90	45	84	30	81	3.75	900	112	304
1925	314	72	43	110	30	131	3.55	1,115	106	465
1926	184	96	38	80	29	37	2.70	497	78	100
1927	300	89	36	165	29	70	2.41	723	70	169
1928	198	58	47	65	38	48	2.69	533	102	129
1929	150	74	50	52	26	22	2.82	423	73	62
1930	116	94	58	30	19	9	2.42	281	46	22
1931	194	133	99	54	25	16	1.35	262	34	22
1932	245	129	96	71	29	49	1.14	279	33	56
1933	216	146	102	60	28	26	1.61	348	45	42
1934	256	131	107	69	31	49	1.95	499	60	96
1935	267	208	99	85	32	51	1.76	470	56	90
1936	211	229	102	61	27	21	1.98	418	53	42
1937	205	242	98	55	27	25	1.64	336	44	41
1938	198	226	85	55	28	30	1.47	291	41	44
1939	238	207	108	60	31	39	1.35	321	42	53
1940	284	206	109	85	28	62	1.47	417	41	91
1941	260	176	79	78	36	67	2.03	528	73	136
1942	243	134	91	78	29	45	2.46	598	71	111
1943	242	106	78	77	36	51	3.28	794	118	167
1944	184	65	39	50	24	71	3.34	615	80	237
1945	144	54	35	50	22	37	3.45	497	76	128
1946	105	44	33	34	15	23	4.30	452	64	99
1947	152	45	35	46	23	48	4.77	725	110	229
1948	120	46	35	38	18	29	4.31	517	78	125
1949	128	35	26	38	19	45	3.54	453	67	159
1950	90	24	18	27	18	27	4.33	390	78	117
1951	68	27	20	20	14	14	4.67	318	65	65
1952	58	29	22	17	12	7	4.50	261	54	32
1953	81	34	26	24	16	15	4.45	360	71	67
1954	52	31	23	16	10	3	4.40	229	44	13
1955	90	38	28	27	18	17	3.75	338	68	64
1956	90	38	28	27	18	17	4.20	378	76	71
1957	42	29	16	10	10	6	4.40	185	44	26

Table 68--Velvet beans: Acreage, yield, production, price, and value, 1924-52

Year	Acres harvested	Yield per acre	Production	Price per ton	Value of production
	1,000 acres	Pounds	1,000 tons	Dollars	1,000 dollars
1924	40	1,000	20	17.60	352
1925	41	850	17	17.40	296
1926	36	1,000	18	18.20	328
1927	35	1,050	18	16.80	302
1928	37	1,100	20	15.80	316
1929	38	1,000	19	16.00	304
1930	37	700	13	16.00	208
1931	41	850	17	11.20	190
1932	45	750	17	8.00	136
1933	49	900	22	14.00	308
1934	57	900	26	17.00	442
1935	58	800	23	16.10	370
1936	66	750	25	18.90	472
1937	68	720	24	18.00	432
1938	64	650	21	18.00	378
1939	78	770	30	16.40	492
1940	89	700	31	18.00	558
1941	97	800	39	20.00	780
1942	89	710	32	21.00	672
1943	90	610	27	25.00	675
1944	41	700	14	28.00	392
1945	25	760	10	29.00	290
1946	22	600	7	35.00	245
1947	18	575	5	35.00	175
1948	8	650	3	35.00	105
1949	4	725	1	35.00	35
1950	5	850	2	35.00	60
1951	3	650	1	35.00	35
1952[1]	2	600	1	35.00	35

---

[1] This series discontinued in 1953.

Table 69--All hay: Acreage, yield, production, price, and value, 1909-58

Year	Acreage harvested	Yield per acre	Volume		Season average price1/		Farm value1/		Income from sales1/	
			Production	Sold	Loose	Baled	Loose	Baled	Loose	Baled
	1,000 acres	Tons	1,000 tons	1,000 tons	Dollars per ton	Dollars per ton	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1909	179	1.34	239	41	11.00	-	2,629	-	451	-
1910	187	1.39	260	42	11.20	-	2,912	-	470	-
1911	182	1.30	236	41	12.70	-	2,997	-	521	-
1912	170	1.21	205	32	12.50	-	2,562	-	400	-
1913	176	1.25	220	33	12.50	-	2,750	-	412	-
1914	174	1.39	241	33	12.20	-	2,940	-	403	-
1915	204	1.20	244	30	12.00	-	2,928	-	360	-
1916	199	1.30	258	26	11.90	-	3,070	-	309	-
1917	201	1.19	240	20	16.80	-	4,032	-	336	-
1918	198	1.14	226	16	21.00	-	4,746	-	336	-
1919	203	1.29	261	25	22.60	-	5,899	-	565	-
1920	200	1.26	253	23	18.20	-	4,605	-	419	-
1921	210	1.17	246	27	13.20	-	3,247	-	356	-
1922	222	1.19	265	34	13.80	-	3,657	-	469	-
1923	235	1.32	310	37	14.60	-	4,526	-	540	-
1924	212	.81	171	19	18.00	-	3,078	-	342	-
1925	195	.94	183	9	17.60	-	3,221	-	158	-
1926	188	1.11	208	33	15.70	-	3,266	-	518	-
1927	206	1.24	255	24	13.60	-	3,468	-	326	-
1928	201	1.38	277	39	13.20	-	3,656	-	515	-
1929	203	1.26	256	28	12.80	-	3,277	-	358	-
1930	217	1.00	216	19	12.00	-	2,592	-	228	-
1931	236	1.42	335	30	8.60	-	2,881	-	258	-
1932	273	1.17	320	32	7.30	-	2,336	-	234	-
1933	277	1.16	321	29	7.70	-	2,472	-	223	-
1934	322	1.03	333	29	9.60	-	3,197	-	278	-

Continued

Table 69--(Continued)--All hay: Acreage, yield, production, price, and value, 1909-58

Year	Acreage harvested	Yield per acre	Volume		Season average price1/		Farm value1/		Income from sales1/	
			Production	Sold	Loose	Baled	Loose	Baled	Loose	Baled
	1,000 acres	Tons	1,000 tons	1,000 tons	Dollars per ton	Dollars per ton	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1935	300	1.07	321	29	9.40	-	3,017	-	273	-
1936	296	1.16	343	29	10.30	-	3,533	-	299	-
1937	288	1.20	345	31	10.00	-	3,450	-	310	-
1938	296	1.12	333	29	9.20	-	3,064	-	267	-
1939	313	1.31	409	35	11.40	-	3,845	-	329	-
1940	329	1.25	411	35	10.80	-	3,617	-	308	-
1941	350	1.25	437	37	11.20	-	4,064	-	344	-
1942	320	1.21	386	36	13.10	-	4,246	-	396	-
1943	344	1.12	384	34	22.20	-	6,336	-	561	-
1944	331	1.19	395	43	-	21.70	-	8,572	-	933
1945	326	1.25	406	47	-	21.40	-	8,688	-	1,006
1946	319	1.26	403	50	-	23.40	-	9,430	-	1,170
1947	300	1.18	354	39	-	24.90	-	8,815	-	971
1948	294	1.12	329	33	-	26.40	-	8,686	-	871
1949	307	1.29	395	41	-	22.50	-	8,888	-	922
1950	320	1.33	427	43	-	24.40	-	10,419	-	1,049
1951	323	1.19	383	42	-	28.50	-	10,916	-	1,197
1952	403	1.17	470	56	-	29.80	-	14,006	-	1,669
1953	435	1.22	529	53	-	25.30	-	13,384	-	1,341
1954	398	1.14	453	41	-	24.40	-	11,053	-	1,000
1955	441	1.36	598	69	-	21.70	-	12,977	-	1,497
1956	390	1.18	461	51	-	22.80	-	10,511	-	1,173
1957	416	1.38	572	72	-	23.00	-	13,156	-	1,656
1958	438	1.42	621							

1/Prices for hay "loose" from 1909 through 1939, for hay "baled" following 1939.

Table 70—Annual legume hay: Acreage, yield, and production, 1919-52

Year	Acreage harvested				Yield per acre	Production
	Soybeans	Cowpeas	Peanuts	Total		
	1,000 acres	1,000 acres	1,000 acres	1,000 acres	Tons	1,000 tons
1919	-	-	-	85	1.20	102
1920	-	-	-	85	1.25	106
1921	-	-	-	94	1.05	99
1922	-	-	-	108	1.05	113
1923	-	-	-	119	1.10	131
1924	32	72	7	111	.85	94
1925	31	65	7	103	.94	97
1926	44	45	8	97	1.07	104
1927	52	57	11	120	1.18	142
1928	53	51	9	113	1.35	153
1929	70	29	10	109	1.15	125
1930	76	43	10	129	.94	121
1931	61	49	15	125	1.27	159
1932	60	80	23	163	1.08	176
1933	72	64	20	156	1.04	163
1934	57	92	20	169	.90	152
1935	59	89	18	166	.98	162
1936	54	78	15	147	.91	134
1937	66	70	13	149	1.04	155
1938	84	64	15	163	1.05	171
1939	86	50	19	155	1.15	178
1940	82	44	19	145	1.05	152
1941	89	38	18	145	1.03	150
1942	70	26	24	120	1.07	128
1943	62	20	28	110	.99	109
1944	34	15	8	57	1.20	72
1945	29	8	6	43	1.30	70
1946	34	9	5	48	1.20	77
1947	21	7	5	33	1.14	64
1948	21	7	4	32	1.05	60
1949	16	6	4	26	1.12	58
1950	14	7	4	25	1.09	25
1951	14	4	4	22	.95	19
1952[1]	20	5	3	28	.96	24

[1] Series discontinued in 1953.

Table 71—Hay (alfalfa, lespedeza, and miscellaneous): Acreage, yield, and production, 1919-58

Year	Alfalfa and alfalfa hay mixtures			Lespedeza hay			Miscellaneous hay		
	Acreage harvested	Yield per acre	Production	Acreage harvested	Yield per acre	Production	Acreage harvested	Yield per acre	Production
	1,000 acres	Tons	1,000 tons	1,000 acres	Tons	1,000 tons	1,000 acres	Tons	1,000 tons
1919	8	2.10	17	-	-	-	-	-	-
1920	8	2.70	22	-	-	-	-	-	-
1921	12	2.70	32	-	-	-	-	-	-
1922	17	2.35	40	-	-	-	-	-	-
1923	20	2.33	47	-	-	-	-	-	-
1924	12	1.25	15	41	.65	27	-	-	-
1925	10	1.55	16	29	.85	25	-	-	-
1926	8	2.00	16	32	1.00	32	-	-	-
1927	9	2.75	25	24	1.30	31	-	-	-
1928	10	2.66	27	23	1.25	29	-	-	-
1929	12	2.45	29	24	1.25	30	58	1.24	72
1930	11	1.75	19	25	1.00	25	52	.98	51
1931	17	2.50	42	29	1.20	35	65	1.52	99
1932	19	2.50	48	27	1.00	27	64	1.08	69
1933	17	1.80	31	30	1.10	33	74	1.27	94
1934	18	1.75	32	33	1.15	38	102	1.09	111
1935	19	1.80	34	37	1.25	46	76	1.01	77
1936	21	2.75	58	49	1.30	64	75	1.11	83
1937	23	2.20	51	45	1.10	50	64	1.30	83
1938	24	1.80	43	40	1.05	42	59	1.17	69
1939	29	2.43	70	56	1.25	70	63	1.29	81

Continued

Table 71--(Continued)--Hay (alfalfa, lespedeza, and miscellaneous): Acreage, yield, and production, 1919-58

Year	Alfalfa and alfalfa hay mixtures			Lespedeza hay			Miscellaneous hay		
	Acreage harvested	Yield per acre	Production	Acreage harvested	Yield per acre	Production	Acreage harvested	Yield per acre	Production
	1,000 acres	Tons	1,000 tons	1,000 acres	Tons	1,000 tons	1,000 acres	Tons	1,000 tons
1940	33	2.15	71	70	1.40	98	68	1.10	75
1941	32	2.10	67	80	1.30	104	79	1.29	102
1942	22	2.10	46	85	1.30	110	74	1.09	81
1943	21	2.00	42	88	1.00	88	104	1.19	124
1944	22	1.75	38	117	1.15	135	109	1.20	131
1945	20	2.20	44	116	1.20	139	120	1.20	144
1946	19	1.80	34	109	1.40	153	117	1.10	129
1947	16	2.00	32	104	1.10	114	123	1.15	141
1948	19	2.10	40	104	1.00	104	116	1.10	128
1949	25	1.90	48	91	1.30	118	122	1.20	157
1950	23	1.90	44	89	1.45	129	131	1.30	170
1951	22	1.80	40	98	1.10	108	134	1.20	161
1952	26	1.90	49	108	1.20	130	154	1.15	177
1953	26	2.00	52	83	1.15	95	177	1.25	221
1954	27	1.70	46	60	1.10	66	159	1.20	191
1955	27	2.10	57	48	1.45	70	230	1.35	310
1956	26	1.80	47	47	1.20	56	196	1.15	225
1957	23	1.80	41	54	1.40	76	210	1.45	304
1958	20	2.00	40	59	1.45	86			

Table 72--Lespedeza seed: Acreage, yield, production, price, and value, 1924-51

Year	Acreage harvested	Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
			Production	Sold			
	Acres	Pounds	1,000 pounds	1,000 pounds	Dollars	1,000 dollars	1,000 dollars
1924	12,000	86	1,032	-	18.30	189	-
1925	14,000	110	1,540	-	16.30	251	-
1926	12,000	120	1,440	-	13.60	196	-
1927	5,400	110	594	-	9.80	58	-
1928	5,000	110	550	-	13.70	75	-
1929	4,500	73	328	-	15.40	51	-
1930	4,800	69	331	-	13.90	46	-
1931	4,200	120	504	-	11.30	57	-
1932	3,700	99	366	-	7.50	27	-
1933	3,500	86	301	-	5.10	15	-
1934	3,400	110	374	-	8.50	32	-
1935	2,900	69	200	-	9.80	20	-
1936	3,700	99	366	-	13.20	48	-
1937	3,000	86	258	-	6.90	18	-
1938	2,500	82	205	-	7.80	16	-
1939	5,400	85	460	-	9.40	43	-
1940	7,100	90	640	-	9.80	63	-
1941	9,000	115	1,000	-	14.90	149	-
1942	11,000	100	1,100	-	15.60	172	-
1943	7,000	81	570	-	30.50	174	-
1944	12,000	115	1,400	1,106	22.60	316	250
1945	11,900	125	1,500	1,125	21.20	318	238
1946	12,100	125	1,500	1,005	26.50	398	266
1947	5,000	100	500	385	30.00	150	116
1948	7,100	93	660	462	30.20	199	140
1949	4,500	100	450	279	25.60	115	71
1950	2,600	115	300	195	32.50	98	63
1951[1]	1,800	94	170	105	31.80	54	33

[1] Series discontinued in 1952.

Table 73--White clover seed: Acreage, yield, production, price, and value, 1930-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Farm value
	Acres	Pounds[1]	1,000 pounds[1]	Dollars[1]	Dollars[1]
1930	--	--	900	23.00	207
1931	--	--	750	17.60	132
1932	--	--	600	16.65	100
1933	--	--	900	12.50	112
1934	--	--	900	16.00	144
1935	--	--	300	13.10	39
1936	10,000	50	500	15.00	75
1937	8,600	35	300	18.20	55
1938	6,700	30	200	26.50	53
1939	6,200	50	310	30.00	93
1940	8,100	40	320	38.80	124
1941	9,500	36	340	51.15	174
1942	11,400	45	510	47.50	242
1943	11,800	61	720	49.50	356
1944	11,800	40	470	59.00	277
1945	11,800	35	410	68.00	279
1946	10,000	40	400	74.00	296
1947	13,000	45	580	43.50	252
1948	12,000	50	600	47.50	285
1949	5,400	50	270	76.00	205
1950	5,100	45	230	80.00	184
1951	17,500	80	1,400	60.00	840
1952	22,000	55	1,210	55.50	672
1953	9,500	33	314	49.00	154
1954	8,500	71	604	63.00	381
1955	11,000	54	594	79.00	469
1956	11,500	57	656	75.00	492
1957	10,000	55	550	67.00	423
1958	8,000	60	480		

[1] Clean seed basis.

Table 74 --Peanuts (picked and threshed): Acreage, yield, production, price, and value, 1909-52

Year	Acreage harvested	Yield per acre	Volume		Season average price per pound	Farm value	Income from sales
			Production	Sold			
	1,000 acres	Pounds	1,000 pounds	1,000 pounds	Cents	1,000 dollars	1,000 dollars
1909	5	600	3,000	690	3.4	102	23
1910	4	700	2,800	340	3.6	101	12
1911	5	725	3,625	981	4.1	149	40
1912	4	700	2,800	520	3.5	98	18
1913	4	725	2,900	605	4.1	119	25
1914	5	750	3,750	1,220	4.3	161	52
1915	6	775	4,650	1,812	4.9	228	89
1916	8	600	4,800	1,716	4.8	230	82
1917	9	650	5,850	2,686	6.3	369	169
1918	8	550	4,400	1,664	6.8	299	113
1919	6	625	3,750	1,318	9.6	360	127
1920	7	600	4,200	1,956	6.5	273	127
1921	8	550	4,400	2,012	6.4	282	129
1922	8	550	4,400	2,012	6.4	282	129
1923	8	450	3,600	1,380	7.3	263	101
1924	6	355	2,130	313	6.3	134	20
1925	5	550	2,750	733	6.1	168	45
1926	6	500	3,000	684	6.8	204	47
1927	9	550	4,950	2,448	7.4	366	181
1928	7	450	3,150	849	7.2	227	61
1929	8	575	4,600	1,948	6.7	308	131
1930	8	415	3,320	395	6.4	212	25
1931	10	575	5,750	1,580	4.2	242	66
1932	14	400	5,600	516	3.8	213	20
1933	12	600	7,200	1,632	4.4	317	72
1934	12	410	4,920	255	4.7	231	12
1935	12	360	4,320	278	4.9	212	14
1936	11	380	4,180	180	5.2	217	9
1937	10	400	4,000	423	5.1	204	22
1938	11	420	4,620	746	4.9	226	37
1939	11	375	4,125	406	5.3	219	22
1940	11	360	3,960	963	5.0	198	48
1941	8	300	2,400	469	5.7	137	27
1942	24	325	7,800	4,662	5.1	398	238
1943	20	340	6,800	4,261	7.3	496	311
1944	5	275	1,375	191	8.4	116	16
1945	5	385	1,925	826	9.0	173	74
1946	4	280	1,120	108	10.8	121	12
1947	4	300	1,200	238	12.9	155	31
1948	3	335	1,005	279	14.0	141	39
1949	3	360	1,080	407	13.4	145	55
1950	3	340	1,020	459	15.0	153	69
1951	3	325	975	485	14.6	142	71
1952 1/	2	350	700	336	15.9	111	53

1/ This series discontinued in 1953.

Table 75--Irish potatoes (all): Acreage, yield, production, price, and value, 1909-58

Year	Acreage harvested	Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
			Production	Sold			
	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1909	20	39.0	780.0	613.2	1.70	1,326	1,042
1910	25	31.2	780.0	561.6	1.30	1,014	730
1911	22	39.6	871.2	688.8	1.417	1,234	976
1912	20	34.2	684.0	501.6	1.83	1,254	920
1913	21	34.8	730.8	552.6	1.63	1,194	903
1914	20	36.6	732.0	577.8	1.617	1,183	934
1915	22	29.4	646.8	462.0	1.75	1,132	808
1916	20	40.2	804.0	633.0	1.90	1,528	1,203
1917	23	40.8	938.4	721.2	4.316	4,051	3,113
1918	34	49.2	1,672.8	1,344.0	1.70	2,844	2,285
1919	20	31.8	636.0	466.8	3.016	1,919	1,408
1920	22	33.0	726.0	534.6	3.65	2,650	1,951
1921	23	37.8	869.4	642.6	2.716	2,362	1,746
1922	24	34.8	835.2	594.6	2.25	1,879	1,338
1923	23	38.4	883.2	654.0	2.416	2,134	1,580
1924	24	37.8	907.2	667.2	2.10	1,905	1,401
1925	29	34.2	991.8	655.2	2.216	2,198	1,452
1926	33	34.2	1,128.6	739.2	3.33	3,762	2,464
1927	36	31.8	1,144.8	718.2	2.816	3,225	2,023
1928	38	39.0	1,482.0	999.0	1.667	2,470	1,665
1929	29	33.6	974.4	574.8	2.50	2,436	1,437
1930	34	36.0	1,224.0	894.6	2.25	2,754	2,013
1931	48	45.0	2,160.0	1,495.2	.83	1,800	1,246
1932	40	30.6	1,224.0	730.9	1.15	1,408	840
1933	38	32.4	1,231.2	814.8	1.217	1,498	991
1934	42	36.0	1,512.0	1,056.6	.85	1,285	898

Continued

Table 75--(Continued)--Irish potatoes (all): Acreage, yield, production, price, and value, 1909-58

Year	Acreage harvested	Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
			Production	Sold			
	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1935	39	39.0	1,521.0	981.0	1.167	1,774	1,144
1936	39	40.8	1,591.2	1,176.6	2.08	3,315	2,451
1937	44	37.2	1,636.8	1,264.8	1.08	1,773	1,370
1938	43	38.4	1,651.2	1,194.6	1.00	1,651	1,195
1939	40	33.6	1,344.0	935.4	1.25	1,680	1,169
1940	40	34.2	1,368.0	955.8	1.35	1,847	1,290
1941	43	36.6	1,573.8	1,132.8	1.017	1,600	1,152
1942	42	36.0	1,512.0	1,065.0	1.85	2,797	1,970
1943	57	37.2	2,120.4	1,481.4	2.616	5,548	3,876
1944	59	34.2	2,017.8	1,574.4	2.03	4,103	3,201
1945	38	37.2	1,413.6	1,102.8	3.216	4,945	3,547
1946	33	34.8	1,148.4	962.4	2.283	3,124	2,197
1947	24	32.4	777.6	671.4	2.667	2,629	1,790
1948	17	36.0	612.0	550.8	3.18	2,705	1,753
1949	14	36.0	504.0	246.0	3.20	1,613	787
1950	14	37.8	532.2	280.2	2.567	1,367	720
1951	12	37.2	444.0	235.8	2.73	1,217	647
1952	10.6	40.8	435.0	246.0	4.48	1,953	1,105
1953	10.9	49.8	544.8	397.2	1.85	1,008	734
1954	11.3	46.2	520.2	343.2	2.216	1,149	758
1955	9.6	30.0	288.0	136.8	4.42	1,273	606
1956	8.3	49.0	407.0	202.3	3.98	1,620	805
1957	8.6	50.0	430.0		2.02	869	
1958	7.1	45.0	320.0				

Table 76--Sweetpotatoes: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
	Planted	Harvested		Production	Sold			
	1,000 acres	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1909	--	57	41.25	2,351.25	744.70	1.218	2,864	907
1910	--	55	42.9	2,359.50	745.25	1.254	2,960	935
1911	--	57	44.55	2,539.35	808.50	1.309	3,324	1,058
1912	--	56	42.9	2,402.40	800.80	1.364	3,276	1,092
1913	--	60	44.0	2,640.00	911.35	1.291	3,408	1,176
1914	--	58	43.45	2,520.10	837.65	1.218	3,070	1,020
1915	--	62	42.9	2,659.80	925.10	1.054	2,805	976
1916	--	64	43.45	2,780.80	992.75	1.327	3,691	1,318
1917	--	62	42.9	2,659.80	946.00	2.036	5,416	1,926
1918	--	64	38.5	2,464.00	883.85	2.672	6,586	2,362
1919	--	68	44.0	2,992.00	1,071.95	2.945	8,813	3,157
1920	--	72	49.5	3,564.00	1,344.20	2.109	7,517	2,835
1921	--	73	44.0	3,212.00	1,313.40	1.527	4,906	2,006
1922	--	64	46.75	2,992.00	1,231.45	1.618	4,842	1,993
1923	--	54	44.0	2,376.00	996.05	2.254	5,357	2,246
1924	--	50	24.75	1,237.50	557.15	3.109	3,848	1,732
1925	--	60	38.5	2,310.00	1,104.95	2.945	6,804	3,255
1926	--	66	42.9	2,831.40	1,144.55	1.927	5,457	2,206
1927	--	83	45.1	3,743.30	1,541.10	1.800	6,738	2,774
1928	--	62	42.35	2,625.70	1,057.65	1.836	4,822	1,942
1929	--	67	40.7	2,726.90	1,163.25	2.109	5,751	2,453
1930	--	60	37.4	2,244.00	960.85	2.018	4,529	1,939
1931	--	83	40.15	3,332.45	1,417.90	1.091	3,635	1,547
1932	--	111	36.3	4,029.30	1,678.60	.836	3,370	1,404
1933	--	98	36.85	3,611.30	1,426.70	1.182	4,268	1,686
1934	--	117	36.3	4,247.10	1,728.10	1.345	5,714	2,325

Continued

Table 76--(Continued)--Sweetpotatoes: Acreage, yield, production, price, and value, 1909-58

Year	Acreage		Yield per acre	Volume		Season average price per cwt.	Farm value	Income from sales
	Planted	Harvested		Production	Sold			
	1,000 acres	1,000 acres	Cwt.	1,000 cwt.	1,000 cwt.	Dollars	1,000 dollars	1,000 dollars
1935	--	123	40.7	5,006.10	2,099.35	1.054	5,279	2,214
1936	--	111	38.5	4,273.50	1,830.40	1.582	6,760	2,895
1937	--	97	41.8	4,054.60	1,821.05	1.254	5,087	2,285
1938	--	109	39.6	4,316.40	1,961.85	1.164	5,023	2,283
1939	--	95	41.8	3,971.00	1,840.85	1.145	4,549	2,109
1940	--	86	31.9	2,743.40	1,203.40	1.382	3,791	1,663
1941	--	90	46.75	4,207.50	2,161.50	1.309	5,508	2,830
1942	--	88	49.5	4,356.00	2,266.55	1.818	7,920	4,121
1943	--	124	44.0	5,456.00	2,907.85	3.290	17,955	9,569
1944	--	100	53.9	5,390.00	3,374.25	2.636	14,210	8,896
1945	--	116	57.75	6,699.00	4,404.40	2.654	17,783	11,692
1946	--	125	49.5	6,187.50	3,982.00	2.854	17,662	11,367
1947	--	94	46.75	4,394.50	2,735.70	2.763	12,145	7,560
1948	--	86	52.25	4,493.50	2,836.90	2.909	13,022	8,253
1949	94	92	52.25	4,783.90	2,976.05	3.072	14,687	9,136
1950	111	107	56.1	5,992.25	3,740.00	1.782	10,666	6,657
1951	75	72	55.0	3,960.00	2,823.15	5.163	20,434	14,567
1952	91	86	51.15	4,386.25	3,401.75	5.072	22,237	17,050
1953	100	94	52.8	4,981.90	3,594.80	3.436	17,138	12,367
1954	94	93	53.9	4,914.25	3,399.00	3.254	15,970	11,047
1955	105	101	58.06	5,858.05	3,867.05	1.810	10,603	7,630
1956	89	84	59.00	4,956.00	3,540.31	2.580	12,786	9,134
1957	86	82	59.00	4,838.00		2.800	13,546	
1958	89	85	56.00	4,760.00				

Table 77--Strawberries[1]: Acreage, yield, production, price, and value, 1918-58

Year	Acreage harvested	Yield per acre	Production	Season average price per pound	Total value
	Acres	Cwt.	1,000 cwt.	Cents	1,000 dollars
1918	4,900	22.32	109.44	15.97	1,748
1919	3,900	31.32	122.04	17.36	2,119
1920	6,500	25.20	163.8	18.61	3,048
1921	8,250	30.60	252.36	18.055	4,556
1922	11,560	27.36	316.44	11.94	3,780
1923	14,350	19.44	279.0	16.67	4,650
1924	14,600	18.36	268.2	18.055	4,842
1925	10,340	15.12	156.24	16.67	2,604
1926	18,500	20.16	372.96	18.56	6,920
1927	21,100	11.88	250.56	14.50	3,633
1928	23,200	20.88	484.56	16.72	8,103
1929	24,000	18.72	449.28	12.28	5,516
1930	22,000	15.84	348.48	14.22	4,956
1931	20,500	32.40	664.2	11.44	7,601
1932	23,000	24.12	554.76	6.72	3,729
1933	18,800	24.48	460.08	7.25	3,336
1934	19,400	23.04	447.12	7.69	3,440
1935	18,800	14.76	277.56	9.36	2,598
1936	14,800	30.24	447.48	9.67	4,326
1937	17,600	29.52	519.48	8.50	4,416
1938	22,000	18.00	396.00[2]	9.72	3,504
1939	20,000	25.20	504.0[2]	9.027	4,459
1940	23,000	16.20	372.6[2]	10.055	3,671
1941	23,000	25.20	579.6[2]	7.916	3,497
1942	21,000	25.92	544.32	11.388	6,199
1943	13,900	16.20	225.36	20.30	4,573
1944	9,500	19.80	187.92	27.8	5,218
1945	10,500	25.20	264.60	28.19	7,462
1946	15,400	25.20	388.08	29.0	11,257
1947	17,800	18.00	320.4	25.06	8,030
1948	14,400	21.60	311.04	28.7	8,930
1949	13,400	16.20	217.08	29.47	6,399
1950	13,300	18.00	239.40	26.64	6,380
1951	13,400	16.20	216.90[3]	24.305	4,574
1952	5,800	23.40	135.72	30.19	4,098
1953	9,000	28.80	259.20	27.58	7,150
1954	10,800	30.60	330.48	20.78	5,977
1955	8,800	14.40	126.72	31.44	3,988
1956	8,400	27.20	228.48	28.5	6,515
1957	8,500	17.0	144.50	32.7	4,240
1958	7,400	19.0	140.60		

---

[1] Includes strawberries for processing.

[2] Includes some quantities not marketed and excluded in computing value; 198,000 crates in 1938; 306,000 crates in 1941.

[3] Includes 160,000 crates not marketed and excluded in computing value in 1951.

Table 78--Peaches: Production, price, and value, 1909-58

Year	Volume		Season average price per bushel	Farm value	Income from sales
	Production	Sold			
	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1909	291	131	.78	227	102
1910	488	298	1.00	488	298
1911	190	65	1.00	190	65
1912	680	473	.80	544	378
1913	437	251	1.50	656	376
1914	320	148	1.00	320	148
1915	385	206	.95	366	196
1916	441	260	.85	375	221
1917	363	187	1.25	454	234
1918	416	233	1.40	582	326
1919	382	201	1.80	688	362
1920	267	117	2.70	721	316
1921	237	94	1.45	344	136
1922	160	41	1.45	232	59
1923	116	28	1.90	220	53
1924	204	68	1.85	377	126
1925	239	98	1.75	418	172
1926	211	74	1.50	316	111
1927	86	10	1.80	155	18
1928	224	82	1.60	358	131
1929	195	65	1.70	332	110
1930	160	45	1.75	280	79
1931	392	203	1.05	412	213
1932	122	31	1.05	128	33
1933	239	97	1.10	263	107
1934	318	179	.75	238	134
1935	280	151	1.05	294	159
1936	347	202	1.10	382	222
1937	232	106	1.25	290	132
1938	271	132	1.00	271	132
1939	327	169	1.05	343	177
1940	358	189	1.00	358	189
1941	334	176	1.05	351	185
1942	319	161	1.30	415	209
1943	176	84	3.10	546	260
1944	296	135	3.00	888	405
1945	265	185	2.95	782	546
1946	201	133	3.05	613	406
1947	148	96	2.85	422	274
1948	139	99	2.90	403	287
1949	76	48	2.80	213	134
1950	54	26	3.40	184	88
1951	63	35	3.40	214	119
1952	66	38	3.30	218	125
1953	120	119	3.10	555	369
1954	70	46	3.65	256	168
1955	*	*	*	*	*
1956	80	64	3.30	264	211
1957	125	107	3.35	419	358
1958	145				

*Less than 500 bushels.

Table 79--Pears: Production, price, and value, 1909-58

Year	Volume		Season average price per bushel	Farm value	Income from sales
	Production	Sold			
	1,000 bushels	1,000 bushels	Dollars	1,000 dollars	1,000 dollars
1909	36	14	-	-	-
1910	31	11	-	-	-
1911	24	6	-	-	-
1912	52	30	-	-	-
1913	47	24	-	-	-
1914	52	30	-	-	-
1915	55	33	-	-	-
1916	52	30	-	-	-
1917	49	26	-	-	-
1918	58	34	-	-	-
1919	59	35	1.25	74	44
1920	48	24	1.75	84	42
1921	46	23	2.29	105	53
1922	62	36	1.71	106	62
1923	42	20	1.70	71	34
1924	60	37	1.90	114	70
1925	69	42	1.45	100	61
1926	68	41	1.30	88	53
1927	52	30	1.40	73	42
1928	73	46	1.35	99	62
1929	70	43	1.35	94	58
1930	81	54	1.30	105	70
1931	127	87	.90	114	78
1932	92	60	.70	64	42
1933	69	45	1.00	69	45
1934	160	119	.55	88	65
1935	113	79	.75	85	59
1936	194	144	.65	126	94
1937	74	51	.70	52	36
1938	207	149	.50	104	74
1939	144	97	.70	101	68
1940	248	185	.50	124	92
1941	171	120	.60	103	72
1942	239	174	.65	155	113
1943	78	51	1.70	133	87
1944	245	183	1.25	306	229
1945	228	143	1.30	226	186
1946	235	130	1.50	288	195
1947	207	101	1.45	233	146
1948	240	95	1.25	200	119
1949	198	60	1.30	156	78
1950	105	45	1.30	136	58
1951	70	22	1.55	108	34
1952	110	54	1.50	165	81
1953	110	54	1.45	160	78
1954	35	27	1.35	107	36
1955	15	6	1.45	22	9
1956	35	20	1.35	47	27
1957	36	21	1.50	54	32
1958	55				

Table 80--Oranges: Production, disposition, price, and value, 1919-57

Year	Production	Farm disposition		Season average price per box	Value of	
		Home consumption	Sold		Production	Sales
	1,000 boxes	1,000 boxes	1,000 boxes	Dollars	1,000 dollars	1,000 dollars
1919	37	12	25	2.79	103	70
1920	42	13	29	1.74	73	50
1921	50	13	37	2.39	120	88
1922	60	14	46	2.29	137	105
1923	75	14	61	.84	63	51
1924	75	15	60	1.72	129	103
1925	100	16	84	2.23	223	187
1926	150	17	133	2.11	316	281
1927	200	19	181	3.51	702	635
1928	220	20	200	2.50	550	500
1929	187	18	169	2.86	535	483
1930	287	22	265	1.53	439	405
1931	245	22	223	1.33	326	297
1932	278	22	256	1.28	356	328
1933	245	24	221	1.44	353	318
1934	293	24	269	1.06	311	285
1935	244	25	219	1.62	395	355
1936	309	25	284	1.62	501	460
1937	238	25	213	1.37	326	292
1938	385	30	355	1.00	385	355
1939	228	22	206	1.10	251	227
1940	253	20	233	1.00	253	233
1941	192	13	179	1.20	230	215
1942	340	16	324	2.25	765	729
1943	240	14	226	3.40	816	768
1944	360	14	346	2.60	936	900
1945	330	14	316	2.55	842	806
1946	410	16	394	1.90	779	749
1947	300	16	284	1.75	525	497
1948	300	16	284	1.85	555	525
1949	370	16	354	2.20	814	779
1950	300	15	285	2.15	645	613
1951	50	5	45	3.80	190	171
1952	50	5	45	3.50	175	158
1953	100	10	90	3.45	345	310
1954	175	10	163	2.85	499	465
1955	195	13	182	2.55	497	464
1956	115	10	105	3.85	443	368
1957	205			3.30	627	

Table 81--Watermelons (market): Acreage, yield, production, price, and value, 1934-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Farm value
	1,000 acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1934	2,900	72	208.8	.283	59
1935	3,100	87	269.7	.300	81
1936	4,900	78	382.2	.333	127
1937	4,800	105	504.0	.320	161
1938	4,600	87	400.2	.377	151
1939	8,000	75	600.0	.477	286
1940	7,200	84	604.8	.520	314
1941	6,800	96	652.8	.563	368
1942	5,400	93	502.2	.750	377
1943	4,800	93	446.4	1.450	647
1944	6,700	84	562.8	1.667	938
1945	6,400	75	480.0	1.733	832
1946	7,400	69	510.6	1.400	715
1947	6,200	84	520.8	1.187	618
1948	5,200	69	358.8	1.500	538
1949	4,700	78	366.6	1.357	497
1950	4,500	75	337.5	1.583	534
1951	3,900	78	304.2	1.567	477
1952	3,500	75	262.5	1.417	372
1953	2,800	75	210.0	1.620	340
1954	2,100	60	126.0	1.427	180
1955	4,300	87	374.0	1.100	411
1956	3,900	85	332.0	1.400	465
1957	4,200	80	336.0	1.500	504
1958	4,200	85	357.0		

Table 82--Tomatoes (market): Acreage, yield, production, price, and value, 1925-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cw.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1925	1,020	53	54	5.66	306
1926	1,690	40	68	3.40	230
1927	1,680	48	80	1.89	151
1928	1,200	52	62	2.36	148
1929	1,100	47	52	2.36	122
1930	1,200	53	64	2.08	132
1931	1,300	52	67	2.36	159
1932	1,600	47	75	2.74	206
1933	2,100	50	104	1.70	177
1934	2,200	53	117	1.32	154
1935	2,700	38	102	1.42	144
1936	2,800	40	111	1.89	210
1937	2,800	37	104	2.36	245
1938	3,100	41	127	1.13	143
1939	3,000	38	114	2.17	248
1940	3,300	42	140	1.51	211
1941	3,300	41	136	2.17	258
1942	3,100	38	118	3.40	360
1943	2,900	29	85	6.60	560
1944	2,600	26	69	6.13	422
1945	2,200	42	93	6.32	590
1946	1,800	32	57	6.60	378
1947	1,500	32	48	4.81	230
1948	1,300	42	55	6.60	364
1949	1,400	37	52	4.81	250
1950	1,200	37	44	10.75	479
1951	1,100	40	43	6.98	303
1952	1,100	37	41	10.38	424
1953	1,000	37	37	15.09	560
1954	1,500	48	72	6.32	452
1955	1,200	40	48	7.80	374
1956	1,000	40	40	14.70	588
1957	1,000	41	45	11.90	536
1958	1,500	45	68		

Table 83--Cabbage (market): Acreage, yield, production, price, and value, 1918-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1918	1,400	80	112	2.75	308
1919	1,540	80	124	2.62	326
1920	1,480	140	208	2.01	418
1921	1,580	128	202	1.12	227
1922	1,670	120	200	1.00	200
1923	2,000	110	220	2.14	470
1924	1,800	70	126	2.44	307
1925	2,500	120	300	1.12	338
1926	3,000	90	270	1.76	475
1927	3,200	96	308	1.09	336
1928	3,500	90	316	1.16	365
1929	3,100	94	292	1.10	323
1930	2,100	66	138	1.79	247
1931	5,400	66	356	.83	295
1932	3,200	80	256	1.32	339
1933	2,200	96	212	1.08	229
1934	9,300	56	520	.53	276
1935	1,800	92	166	1.15	191
1936	3,600	70	252	.92	233
1937	4,200	66	278	1.15	320
1938	3,800	84	320	.73	210
1939	4,600	72	332	1.02	299
1940	4,600	72	332	1.20	350
1941	4,600	84	386	1.10	425
1942	5,700	86	490	.82	404
1943	5,100	64	326	3.38	1,100
1944	7,700	86	662	1.40	913
1945	7,500	90	676	1.30	879
1946	7,400	94	696	2.00	1,392
1947	8,000	90	720	.99	713
1948	5,000	80	400	2.26	904
1949	5,300	84	446	1.45	647
1950	5,600	104	582	.77	448
1951	1,800	70	126	3.08	388
1952	3,000	100	300	2.90	870
1953	5,200	110	572	.84	483
1954	3,700	80	296	1.26	374
1955	3,900	78	304	1.65	502
1956	3,500	100	350	1.25	438
1957	3,300	90	297	1.95	579
1958	3,000	60	180		

Table 84—Snap beans (mid-spring market): Acreage, yield, production, price, and value, 1918-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	1,000 acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1918	1,400	28.5	39.9	7.50	299
1919	1,500	25.5	38.4	7.85	301
1920	1,300	19.5	25.2	7.50	189
1921	2,000	24.0	48.0	9.15	440
1922	1,460	23.4	34.2	5.35	182
1923	1,540	21.0	32.4	8.50	275
1924	3,200	26.4	84.6	6.00	508
1925	5,000	22.2	111.0	4.50	500
1926	5,500	16.8	92.4	7.15	662
1927	6,200	16.5	102.3	4.50	460
1928	7,400	16.5	122.1	5.15	631
1929	8,000	24.0	192.0	4.50	864
1930	8,400	19.8	166.2	3.50	582
1931	8,000	22.8	182.4	2.70	492
1932	7,600	19.5	148.2	1.85	243
1933	4,500	19.5	87.6	2.75	239
1934	8,000	21.0	168.0	2.40	333
1935	8,800	20.4	179.4	2.35	425
1936	8,800	19.2	168.9	4.00	676
1937	9,200	16.5	151.8	3.85	582
1938	10,900	18.0	196.2	2.35	458
1939	9,200	16.5	151.8	3.00	455
1940	7,300	16.5	120.6	3.85	345
1941	6,600	19.5	128.7	4.15	536
1942	7,400	21.0	155.4	4.65	725
1943	8,000	15.0	120.0	7.65	920
1944	6,000	22.5	135.0	7.50	1,012
1945	6,000	27.0	162.0	8.35	1,350
1946	7,200	18.0	129.6	7.00	907
1947	5,400	15.0	81.0	7.65	621
1948	4,500	21.0	94.5	9.15	866
1949	3,700	22.5	83.4	9.15	764
1950	4,400	24.0	105.6	8.15	862
1951	4,200	22.5	94.5	8.35	788
1952	4,000	21.0	84.0	9.00	756
1953	3,800	22.5	85.5	8.35	712
1954	4,000	30.0	120.0	5.50	660
1955	3,200	21.0	67.0	6.65	386
1956	2,500	25.0	62.0	9.10	564
1957	2,700	27.0	73.0	8.40	613
1958	3,000	28.0	84.0		

Table 85--Snap beans (early fall market): Acreage, yield, production, price, and value, 1922-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1922	300	21.0	6.3	5.85	37
1923	700	24.0	16.8	6.15	104
1924	900	22.5	20.4	6.15	126
1925	3,200	14.7	47.1	6.15	290
1926	3,300	19.5	64.2	5.50	353
1927	3,600	16.2	58.2	4.35	252
1928	3,200	21.9	70.2	5.15	363
1929	4,000	22.5	90.0	3.65	330
1930	3,600	12.6	45.3	3.45	156
1931	2,600	19.5	50.7	3.15	161
1932	2,600	16.5	42.9	2.00	86
1933	3,700	15.0	55.5	2.25	126
1934	4,900	16.5	81.0	2.65	216
1935	5,600	14.4	80.7	3.35	269
1936	6,200	13.2	81.9	3.00	246
1937	4,400	15.0	66.0	4.50	297
1938	3,700	22.5	83.4	2.65	222
1939	4,000	19.5	78.0	3.15	247
1940	4,400	24.0	105.6	2.15	229
1941	3,000	12.0	36.0	5.50	198
1942	2,400	16.5	39.6	6.35	251
1943	2,100	20.1	42.3	8.00	338
1944	2,200	22.5	49.5	8.15	404
1945	3,000	25.5	76.5	9.15	701
1946	2,900	27.0	78.3	8.00	626
1947	2,400	15.0	36.0	8.00	288
1948	2,000	24.0	48.0	7.65	368
1949	2,000	22.5	45.0	5.00	225
1950	2,200	25.5	56.1	7.35	411
1951	1,800	22.5	40.5	9.85	398
1952	1,700	18.0	30.6	10.65	326
1953	1,600	22.5	36.0	6.50	234
1954	1,200	19.5	23.4	8.15	191
1955	1,000	26.0	26.0	6.00	132
1956	1,400	35.0	49.0	6.10	299
1957	1,200	23.0	28.0	8.30	191
1958	800	20.0	16.0		

Table 86.—Onions (market): Acreage, yield, production, price, and value, 1918-52

Year	Acreage harvested	Yield per acre	Production, 50-lb. sacks	Season average price per 50-lb. sack	Total value
	Acres	50-lb. sacks	1,000	Dollars	1,000 dollars
1918	1,560	190	296	1.60	474
1919	970	160	155	2.85	442
1920	1,080	158	171	1.86	318
1921	1,010	206	208	.95	198
1922	1,100	300	330	1.51	498
1923	1,200	90	108	1.79	193
1924	1,670	124	207	.89	184
1925	2,320	120	278	1.36	378
1926	2,750	128	352	1.17	412
1927	2,900	108	313	1.22	382
1928	2,300	130	299	.88	263
1929	2,200	130	286	1.08	309
1930	1,260	60	76	1.15	87
1931	1,100	90	99	1.00	99
1932	1,200	80	96	.80	77
1933	500	70	35	.88	31
1934	1,600	84	134	.50	67
1935	1,200	82	98	.83	81
1936	1,100	108	119	.88	105
1937	1,700	108	184	.65	120
1938	1,700	100	170	.72	122
1939	1,600	112	179	.70	125
1940	1,400	82	115	1.30	150
1941	1,700	100	170	1.08	184
1942	1,900	110	209	.88	184
1943	1,550	90	140	1.65	231
1944	1,800	90	162	2.60	421
1945	2,000	120	240	2.10	504
1946	2,000	105	210	2.20	462
1947	1,100	80	88	1.70	150
1948	450	95	43	2.60	112
1949	500	100	50	2.00	100
1950	450	95	43	1.50	64
1951	400	90	36	2.15	77
1952[1]	350	90	32	3.35	107

---

[1] Series discontinued in 1953.

Table 87—Shallots (spring market): Acreage, yield, production, price, and value, 1937-58

Year	Acreage harvested	Yield per acre cwt. or barrel	Production	Season average price per cwt. or barrel	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1937	2,800	31	87	2.68	232
1938	2,700	24	64	3.92	251
1939	2,400	34	82	1.80	125
1940	2,000	34	68	2.40	163
1941	1,900	35	66	3.80	253
1942	2,400	35	84	3.12	260
1943	2,300	21	48	7.12	341
1944	2,100	20	42	10.00	420
1945	2,200	26	57	5.36	305
1946	2,200	25	55	7.60	418
1947	2,000	25	50	7.20	360
1948	1,900	25	48	6.20	298
1949	1,600	15	24	8.32	199
1950	1,900	28	53	6.44	334
1951	2,000	27	54	7.20	390
1952	2,500	33	82	5.00	424
1953	1,900	29	55	7.72	425
1954	1,900	27	51	4.40	347
1955	2,700	29	78	5.20	406
1956	2,600	30	78	4.40	343
1957	2,000	20	40	6.20	248
1958	1,700	25	42		

Table 88—Shallots (winter market): Acreage, yield, production, price, and value, 1937-58

Year	Acreage harvested	Yield per acre cwt. or barrel	Production	Season average price per cwt. or barrel	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1937	3,200	29	94	3.00	280
1938	3,000	20	58	4.60	269
1939	3,000	29	87	2.20	191
1940	2,700	30	81	2.80	227
1941	2,200	26	57	3.60	206
1942	2,800	31	87	3.40	296
1943	2,700	27	73	5.00	365
1944	1,900	25	48	9.00	432
1945	2,700	35	94	7.52	705
1946	3,200	35	112	7.60	851
1947	2,700	22	59	8.72	513
1948	2,900	28	81	6.76	547
1949	2,900	25	72	6.56	472
1950	2,600	24	62	9.60	595
1951	3,000	20	60	11.20	677
1952	3,500	33	116	6.80	789
1953	3,500	29	102	11.00	1,122
1954	2,800	27	76	11.20	851
1955	4,600	33	148	5.60	757
1956	2,900	20	58	7.40	429
1957	2,900	20	58	7.50	435
1958	2,200	25	55		

Table 89--Garlic (market): Acreage, yield, production, price, and value, 1932-52

Year	Acreage harvested	Yield per acre	Production 100-lb. sacks	Season average price per 100-lb. sack	Total value
	Acres	100-lb. sack	1,000	Dollars	1,000 dollars
1932	500	14.0	7	2.50	18
1933	500	12.0	6	5.50	33
1934	500	14.0	7	3.50	24
1935	700	13.3	9	2.50	22
1936	500	13.8	7	4.50	32
1937	600	13.9	8	4.50	36
1938	750	14.2	11	4.50	50
1939	700	13.8	10	3.75	38
1940	700	13.6	10	4.00	40
1941	770	13.8	11	6.00	66
1942	700	14.0	10	4.00	40
1943	480	13.6	7	5.00	35
1944	380	13.0	5	8.00	40
1945	310	13.0	4	15.50	62
1946	250	12.5	3	20.00	60
1947	180	13.5	2	13.50	27
1948	130	12.5	2	10.50	21
1949	100	12.5	1	9.80	10
1950	90	13.0	1	9.20	9
1951	60	13.0	1	10.60	11
1952[1]	50	13.0	1	10.00	10

[1] This series discontinued in 1953.

Table 90—Green peppers (market): Acreage, yield, production, price, and value, 1924-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1924	850	43.75	37.25	5.20	194
1925	1,700	40.00	68.00	4.80	326
1926	2,000	37.50	75.00	5.60	420
1927	1,600	45.00	72.00	4.80	346
1928	2,100	35.00	73.50	3.60	265
1929	1,300	50.00	65.00	3.72	242
1930	1,150	37.50	43.00	2.80	120
1931	1,100	55.00	60.50	2.60	157
1932	900	32.50	29.25	3.40	99
1933	1,050	52.50	55.00	2.40	132
1934	1,050	36.25	38.00	1.92	73
1935	1,250	55.75	69.75	1.96	137
1936	1,300	37.50	48.75	1.92	94
1937	1,200	50.00	60.00	2.40	144
1938	1,600	55.00	88.00	2.00	176
1939	1,400	35.00	49.00	4.40	216
1940	1,150	35.00	40.25	3.20	129
1941	1,300	50.00	65.00	2.40	156
1942	1,100	37.00	40.75	4.60	187
1943	1,100	55.00	60.50	13.00	786
1944	1,800	41.25	74.25	7.60	564
1945	2,000	42.50	85.00	8.80	748
1946	2,500	25.00	62.50	8.80	550
1947	2,500	33.75	84.50	11.00	930
1948	2,700	40.00	108.00	8.00	864
1949	3,000	33.75	101.25	10.40	1,053
1950	2,700	28.75	77.50	6.00	465
1951	2,900	35.00	101.50	3.80	386
1952	2,800	32.50	91.00	17.80	1,620
1953	2,400	27.50	66.00	17.40	1,148
1954	3,400	45.00	153.00	4.60	604
1955	2,300	42.00	97.00	6.00	516
1956	1,900	28.00	53.00	13.20	700
1957	2,100	38.00	80.00	10.20	816
1958	2,200	35.00	77.00		

Table 91—Carrots (market): Acreage, yield, production, price, and value, 1923-52

Year	Acreage harvested	Yield per acre	Production	Season average price per bushel	Total value
	Acres	Bushels	1,000 bushels	Dollars	1,000 dollars
1923	1,220	270	329	.78	257
1924	1,270	235	298	1.03	307
1925	2,360	243	573	.70	401
1926	3,750	172	645	.70	452
1927	4,750	211	1,002	.51	511
1928	2,500	171	428	.51	218
1929	2,300	169	389	.62	241
1930	2,300	125	288	.50	144
1931	2,200	105	231	.31	72
1932	2,200	100	220	.40	88
1933	2,100	90	189	.37	70
1934	2,100	120	252	.32	81
1935	1,900	123	234	.60	140
1936	1,900	120	228	.40	91
1937	1,900	138	262	.60	157
1938	2,200	130	286	.40	114
1939	2,200	147	323	.45	145
1940	2,000	120	240	.55	132
1941	2,000	125	250	.55	138
1942	1,800	125	225	.80	180
1943	1,700	70	119	1.70	202
1944	1,500	65	98	1.85	181
1945	1,500	70	105	2.10	220
1946	900	70	63	2.40	151
1947	800	65	52	2.30	120
1948	750	65	49	2.70	132
1949	700	65	46	2.25	104
1950	650	65	42	2.25	94
1951	550	55	30	2.90	87
1952[1]	550	60	33	3.10	102

[1] Series discontinued in 1953.

Table 92--Cucumbers (early fall market): Acreage, yield, production, price, and value, 1928-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1928	800	42	34	2.92	98
1929	780	40	31	2.60	81
1930	800	36	29	2.04	59
1931	850	40	34	1.85	63
1932	950	38	36	1.92	70
1933	900	39	36	1.87	67
1934	650	37	24	2.08	50
1935	850	36	31	1.87	58
1936	750	43	33	1.35	44
1937	800	31	25	2.81	70
1938	900	43	39	1.87	73
1939	1,200	55	66	1.42	94
1940	900	38	35	2.19	76
1941	900	35	31	2.40	75
1942	750	41	31	5.94	182
1943	1,050	48	50	6.66	336
1944	1,500	40	60	2.81	170
1945	1,000	48	48	7.29	350
1946	1,200	58	69	4.17	288
1947	900	29	26	6.98	181
1948	900	31	28	4.79	133
1949	1,100	38	42	3.75	126
1950	1,200	60	72	4.17	300
1951	900	26	24	5.52	132
1952	900	50	45	3.96	179
1953	1,000	48	48	4.58	200
1954	600	29	36	1.60	76
1955	500	43	26	3.55	78
1956	600	44	26	4.30	112
1957	700	35	24	4.10	86
1958	500	25	12		

Table 93--Cucumbers (late spring market): Acreage, yield, production, price, and value, 1923-58

Year	Acreage harvested	Yield per acre	Production	Season average price per cwt.	Total value
	Acres	Cwt.	1,000 cwt.	Dollars	1,000 dollars
1923	250	41	10	3.75	38
1924	450	48	22	3.64	79
1925	500	34	17	4.06	68
1926	700	38	27	3.33	90
1927	650	41	26	2.50	66
1928	900	41	36	2.60	95
1929	660	43	28	2.73	77
1930	800	47	37	2.21	83
1931	400	58	23	1.96	45
1932	450	48	22	1.25	27
1933	450	36	16	1.21	20
1934	480	36	17	1.04	18
1935	600	43	26	1.46	38
1936	500	41	20	2.08	42
1937	550	38	21	1.77	37
1938	500	38	19	1.15	22
1939	500	43	22	1.77	38
1940	550	38	21	2.08	44
1941	600	46	28	1.71	48
1942	600	46	27	2.08	57
1943	480	43	21	4.79	99
1944	1,000	48	48	4.37	210
1945	850	46	39	4.79	186
1946	1,000	48	48	3.44	165
1947	800	29	23	3.44	79
1948	750	48	36	5.21	188
1949	650	38	25	4.06	101
1950	600	48	29	3.75	108
1951	600	46	27	3.12	86
1952	600	48	29	5.31	153
1953	450	38	17	6.04	104
1954	600	55	44	3.33	147
1955	800	60	48	3.55	135
1956	600	48	29	6.00	174
1957	600	50	30	3.95	118
1958	600	60	36		

Table 94—Spinach (market): Acreage, yield, production, price, and value, 1925-52

Year	Acreage harvested	Yield per acre	Production	Season average price per bushel	Total value
	Acres	Bushels	1,000 bushels	Dollars	1,000 dollars
1925	1,900	105	200	.40	80
1926	1,700	100	170	.50	85
1927	1,650	110	182	.45	82
1928	2,100	107	225	.48	108
1929	2,000	100	200	.48	96
1930	1,990	50	100	.50	50
1931	1,500	70	105	.40	42
1932	1,200	85	102	.40	41
1933	1,200	105	126	.30	38
1934	1,500	95	142	.29	41
1935	1,200	85	102	.45	46
1936	1,100	102	112	.35	39
1937	1,100	100	110	.60	66
1938	1,200	115	138	.50	69
1939	1,350	110	148	.48	71
1940	1,350	87	117	.55	64
1941	1,250	96	120	.60	72
1942	1,150	87	100	.75	75
1943	1,000	75	75	1.15	86
1944	1,000	70	70	1.05	74
1945	900	75	68	1.15	78
1946	900	70	63	1.20	76
1947	800	65	52	1.35	70
1948	650	70	46	1.45	67
1949	600	70	42	1.50	63
1950	500	75	38	1.20	46
1951	400	45	18	1.90	34
1952 1/	300	70	21	1.45	30

1/Series discontinued in 1953.

Table 95.—Eggplant (market): Acreage, yield, production, price, and value, 1925-52

Year	Acreage harvested	Yield per acre	Production	Season average price per bushel	Total value
	Acres	Bushels	1,000 bushels	Dollars	1,000 dollars
1925	400	190	76	1.05	80
1926	540	130	70	1.05	74
1927	450	156	70	1.00	70
1928	680	159	108	.90	97
1929	650	154	100	1.30	130
1930	600	147	88	.87	77
1931	500	144	72	1.50	108
1932	500	158	79	1.00	79
1933	500	146	73	.75	55
1934	550	150	82	.50	41
1935	650	156	101	.75	76
1936	550	100	55	.60	33
1937	500	138	69	.65	45
1938	750	150	112	.45	50
1939	700	125	88	.70	62
1940	600	140	84	.85	71
1941	550	140	77	.90	69
1942	500	145	72	1.20	86
1943	500	170	85	1.50	128
1944	450	155	70	1.35	94
1945	400	150	60	1.95	117
1946	400	135	54	1.60	86
1947	350	145	51	1.45	74
1948	330	135	45	1.35	61
1949	300	140	42	1.60	67
1950	300	150	45	1.30	58
1951	300	150	45	1.30	58
1952 1/	300	150	45	1.85	83

1/Series discontinued in 1953.

Table 96--Beets (market): Acreage, yield, production, price, and value, 1927-52

Year	Acreage harvested	Yield per acre	Production	Season average price per bushel	Total value
	Acres	Bushels	1,000 bushels	Dollars	1,000 dollars
1927	3,000	60	180	.50	90
1928	2,700	172	464	.56	260
1929	2,500	170	425	.48	204
1930	2,300	130	299	.64	191
1931	2,200	117	257	.36	93
1932	2,100	115	242	.45	109
1933	2,100	104	218	.38	83
1934	2,200	135	297	.30	89
1935	2,000	135	270	.48	130
1936	1,500	125	188	.40	75
1937	1,500	145	218	.55	120
1938	1,100	140	154	.40	62
1939	1,100	145	160	.45	72
1940	1,000	130	130	.50	65
1941	900	135	122	.50	61
1942	800	100	80	.75	60
1943	700	110	77	1.15	89
1944	700	90	63	1.15	72
1945	500	100	50	1.15	58
1946	500	110	55	1.15	63
1947	350	60	21	1.65	35
1948	250	55	14	2.10	29
1949	300	60	18	2.30	41
1950	200	80	16	1.85	30
1951	120	55	7	2.15	15
1952[1]	100	65	6	2.10	13

---

[1] Series discontinued in 1953.

Table 97--Vegetables for commercial processing: Acreage, production, price, and value, 1928-57

Year	Acreage harvested	Production	Season average price	Total value
	Acres	Tons	Dollars per ton	1,000 dollars
1928	3,640	2,100	61.40	129
1929	3,640	4,020	46.00	185
1930	5,840	6,230	32.40	202
1931	2,620	2,610	32.20	84
1932	1,630	1,840	22.80	42
1933	1,110	1,700	18.80	32
1934	1,680	1,530	21.55	33
1935	2,230	3,130	16.60	52
1936	2,680	2,130	21.10	45
1937	3,680	5,850	21.70	127
1938	3,300	4,510	22.40	101
1939	2,000	2,500	26.40	66
1940	3,550	5,100	23.90	122
1941	4,950	5,400	26.85	145
1942	5,200	7,800	37.55	293
1943	5,800	6,000	65.40	393
1944	4,300	4,600	59.50	276
1945	3,430	5,800	56.15	324
1946	3,620	4,000	70.35	282
1947	3,190	3,800	76.39	275
1948	1,830	1,900	68.30	127
1949	1,780	1,800	65.00	117
1950	2,000	3,800	40.20	153
1951	1,250	2,100	63.50	127
1952	1,100	1,600	68.13	109
1953	1,410	1,000	85.00	85
1954	1,860	2,200	68.20	150
1955	2,200	5,400	36.30	196
1956	2,600	6,400	34.55	221
1957	1,360	1,600	39.40	63

Table 98--Pecans (improved and seedling): Production, price, and value, 1919-58

Year	Production			Quantity Sold			Season Average Price[1]			Total farm value all varieties	Cash receipts all varieties
	Improved varieties	Wild or seedling varieties	Total	Improved varieties	Wild or seedling varieties	Total	Improved varieties	Wild or seedling varieties	Total		
	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	Cents per pound	Cents per pound	Cents per pound	1,000 dollars	1,000 dollars
1919	750	4,250	5,000	--	--	--	--	--	29.0	1,450	1,160
1920	100	600	700	--	--	--	--	--	31.0	217	109
1921	920	9,680	5,600	--	--	--	--	--	21.0	1,176	966
1922	100	500	600	--	--	--	40.0	18.0	21.7	130	57
1923	720	3,530	4,250	--	--	--	37.0	15.0	18.7	796	626
1924	310	1,440	1,750	--	--	--	42.0	23.0	26.3	461	238
1925	1,020	4,510	5,530	--	--	--	32.0	17.0	19.8	1,093	897
1926	1,110	4,890	6,000	--	--	--	32.0	14.0	17.3	1,040	865
1927	440	1,810	2,250	--	--	--	38.0	16.0	20.3	457	280
1928	1,070	4,430	5,500	--	--	--	27.0	10.7	13.9	763	626
1929	532	2,128	2,660	--	--	--	31.0	15.0	18.2	484	339
1930	1,595	6,378	7,973	--	--	--	24.0	12.0	14.4	1,148	1,004
1931	1,802	6,390	8,192	--	--	--	16.0	7.5	9.4	767	676
1932	1,356	4,808	6,164	--	--	--	13.0	7.0	8.3	513	437
1933	2,326	8,249	10,575	--	--	--	10.5	6.0	7.0	739	663
1934	960	3,212	4,172	--	--	--	17.0	11.0	12.4	516	418
1935	1,934	6,858	8,792	--	--	--	13.8	7.3	8.7	768	687
1936	1,722	5,454	7,176	--	--	--	16.3	10.9	12.2	875	766
1937	3,326	7,762	11,088	2,876	7,112	9,988	12.0	6.5	8.2	904	807
1938	2,140	4,548	6,688	1,790	3,998	5,788	13.0	7.8	9.5	633	545
1939	2,153	5,023	7,176	1,853	4,523	6,376	13.9	7.7	9.6	686	606

Continued

Table 98--(Continued)--Pecans (improved and seedling): Production, price, and value, 1919-58

Year	Production			Quantity Sold			Season Average Price[1]			Total farm value all varieties	Cash receipts all varieties
	Improved varieties	Wild or seedling varieties	Total	Improved varieties	Wild or seedling varieties	Total	Improved varieties	Wild or seedling varieties	Total		
	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	Cents per pound	Cents per pound	Cents per pound	1,000 dollars	1,000 dollars
1940	3,074	5,710	8,784	2,674	5,110	7,784	13.2	7.8	9.7	851	752
1941	1,400	4,200	5,600	1,100	3,700	4,800	15.6	8.2	10.0	562	475
1942	1,900	4,500	6,400	1,600	4,000	5,600	19.8	13.5	15.4	984	857
1943	2,640	9,360	12,000	2,240	8,760	11,000	26.0	18.5	20.2	2,418	2,203
1944	3,744	10,656	14,400	3,314	9,936	13,250	25.7	16.2	18.6	2,688	2,462
1945	1,900	7,700	9,600	1,480	7,100	8,580	26.2	20.0	21.1	2,038	1,808
1946	2,300	7,150	9,450	1,880	6,550	8,430	35.1	29.4	30.7	2,909	2,586
1947	1,500	4,000	5,500	1,150	3,500	4,650	35.5	21.0	24.6	1,372	1,372
1948	4,700	14,300	19,000	4,350	13,650	18,000	18.0	10.5	12.3	2,348	2,216
1949	3,950	13,050	17,000	3,600	12,400	16,000	21.0	16.0	17.1	2,918	2,740
1950	1,900	7,200	9,100	1,600	6,600	8,200	32.0	25.0	26.4	2,408	2,162
1951	3,450	12,250	15,700	3,100	11,600	14,700	24.0	18.0	19.3	3,033	2,832
1952	3,200	10,300	13,500	2,900	9,700	12,600	25.0	18.5	20.0	2,706	2,519
1953	6,000	18,000	24,000	5,650	17,350	23,000	18.0	15.0	15.7	3,780	3,619
1954	3,750	6,750	10,500	3,500	6,250	9,750	31.0	23.0	25.9	2,714	2,523
1955	2,000	23,000	25,000	1,800	22,300	24,100	35.0	29.0	29.5	7,370	7,097
1956	3,600	10,400	14,000	3,300	9,900	13,200	19.0	18.0	18.2	2,409	2,275
1957	2,200	14,900	17,100	1,900	14,400	16,300	28.5	21.5	22.3	3,638	
1958	4,000	12,000	16,000								

[1] December 1 price prior to 1937.

Table 99—Tung nuts: Production, price, and value, 1939-57

Year	Production[1]	Season average price per ton	Farm value
	Tons	Dollars	1,000 dollars
1939	150	39.00	6
1940	1,200	55.00	66
1941	1,800	91.00	164
1942	4,000	87.00	348
1943	3,260	100.00	326
1944	7,550	103.00	778
1945	10,750	101.00	1,086
1946	15,200	90.00	1,368
1947	15,500	64.00	992
1948	14,000	50.00	700
1949	25,200	64.00	1,613
1950	6,100	94.00	573
1951	2,900	97.00	281
1952	30,200	77.00	2,325
1953	21,700	65.00	1,410
1954	4,900	58.00	284
1955[2]			
1956	18,300	54.00	988
1957	18,900	57.00	1,077

1/Includes small quantities of tung nuts produced in Texas.
2/Production negligible due to freeze.

Table 100—Tobacco (perique): Acreage, yield, production, price, and value, 1919-58

Year	Acreage harvested	Yield per acre	Production	Season average price per pound	Farm value
	Acres	Pounds	1,000 pounds	Cents	1,000 dollars
1919	800	435	348	65.0	226
1920	800	475	380	40.0	152
1921	900	465	418	55.0	230
1922	1,100	435	478	55.0	263
1923	900	440	396	50.0	198
1924	800	400	320	55.0	176
1925	800	450	360	55.0	198
1926	100	400	40	45.0	18
1927	100	420	42	45.0	19
1928	200	405	81	45.0	36
1929	300	400	120	40.0	48
1930	600	445	267	30.0	80
1931	600	410	246	26.0	64
1932	400	430	172	27.5	47
1933	300	425	128	23.0	29
1934	100	350	35	20.0	7
1935	100	420	42	18.0	8
1936	100	480	48	25.0	12
1937	400	500	200	30.0	60
1938	600	500	300	30.0	90
1939	1,000	370	370	27.0	100
1940	500	275	138	25.0	34
1941	200	285	57	17.0	10
1942	200	350	70	30.0	21
1943	300	500	150	40.0	60
1944	400	525	210	42.5	89
1945	300	640	192	65.0	125
1946	300	500	150	80.0	120
1947	600	415	249	60.0	149
1948	300	800	240	60.0	144
1949	300	667	200	60.0	120
1950	400	375	150	60.0	90
1951	400	660	264	60.0	158
1952	350	650	228	56.0	128
1953	300	560	168	68.0	114
1954	300	800	240	59.0	142
1955	200	750	150	60.0	90
1956	280	555	155	68.5	106
1957	240	650	156	74.0	115
1958	220	675	148		

Bulletin No. 520
March 1959

0.7
73b

OWNERSHIP FACTORS AFFECTING MANAGEMENT OF SMALL WOODLANDS

in St. Helena Parish, Louisiana

by ROBERT W. McDERMID, PAUL D. KITT & SAM GUTTENBERG

ricultural Experiment Station
Charles W. Upp, Director

Louisiana State University and
Agricultural and Mechanical College

In Cooperation With
Southern Forest Experiment Station, Forest Service
U. S. Department of Agriculture

CONTENTS

Page

The Study Area 5

Study Methods 6

Results 9

Conclusions 13

Literature Cited 14

Appendix 15

Cover photograph by U. S. Forest Service

OWNERSHIP FACTORS AFFECTING MANAGEMENT OF SMALL WOODLANDS IN ST. HELENA PARISH, LOUISIANA

Robert W. McDermid,[1] Paul D. Kitt,[2] and Sam Guttenberg[3]

A large proportion of the South's forest land has always been held by small owners. The monumental "Timber Resources for America's Future," published by the United States Forest Service in 1958, reveals that small holdings of less than 500 acres comprise more than 52 percent of the commercial forest land in the South (*14*).[4] In Louisiana this ownership class takes in 41 percent of all forest land. Of perhaps greater importance to the administrators of public and private forestry programs is the fact that the overwhelming majority of Louisiana's landowners are in this class.

The apparent lack of progressive forest management by most small owners has long concerned foresters. Many authorities have called attention to the problem and have emphasized that profitable management of these holdings would mean greater returns to landowners, as well as more and better employment opportunities and improved rural living generally (*1, 5, 7*).

Though conservationists are in widespread agreement as to the benefits to be had from timber growing, most small-tract owners have been slow to seize the opportunities that have often been pointed out to them. In a partial attempt to explain the gap between precept and performance, small-tract owners in St. Helena Parish were interviewed and their woodlands examined.

THE STUDY AREA

St. Helena is in the geographic center of that portion of Louisiana called the Florida Parishes. Residents of these parishes derive much of their livelihood from the forest resource. Timber growth rates are good, and the potentialities of forest management are high. In the parish studied, 43 percent—very close to the state average—of the land is in holdings of less than 500 acres. The proprietors of these small tracts make up 98 percent of the parish's forest owners. Of the acreage held by the remaining 2 percent of the owners, four-fifths is the property of wood-using corporations.

---

[1] Associate Professor of Forestry, Louisiana State University.

[2] Instructor of Forestry, McNeese State College. Formerly graduate student, School of Forestry, Louisiana State University.

[3] Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.

[4] Italic numbers in parentheses refer to Literature Cited, p. 14.

Entirely rural in population, the parish contains 268,800 acres of flat to gently rolling land. Of the total area, 79 percent, or 212,900 acres, supports commercial timber (*11*). All of the forest is privately owned, 42 percent of it by forest industries.

The loblolly-shortleaf pine type predominates, covering all the upland except for a small area of longleaf pine in the southern part. Hardwoods occupy the floodplains of the principal rivers, the Tickfaw and Amite.

The area enjoys typical Gulf Coastal Plain climate—abundant rainfall and a long growing season. Precipitation averages 62 inches annually and is fairly well distributed throughout the year (*15*). The length of the growing season is not recorded, but adjacent East Baton Rouge Parish has an average growing season of 269 days (*3*).

STUDY METHODS

The Louisiana Tax Commission lists 1,496 St. Helena Parish landowners who possess less than 500 acres of forest (*6*). Ownership data from the tax rolls are summarized in Table 1. The Commission's list of small owners was used as the basis for sampling, except that the 450 owners with less than 20 acres apiece were deleted in an attempt to exclude properties held primarily for residential purposes. From the 1,046 owners of tracts ranging from 20 to 499 acres, a sample of 51 was drawn with the aid of a table of random sampling numbers (*10*). The sample was distributed among wards in proportion to each ward's share of the total number of landowners in the parish. As each owner was drawn, his name, address, and forest acreage was recorded. In some instances, field contact disclosed that the ownership no longer met

TABLE 1.—Forest Landownership in St. Helena Parish, Louisiana

Ownership class (acres)	Owners	Average holding	Total holdings in class	Proportions of total
	Number	*Acres*	*Acres*	*Percent*
0-19	450	10	4,398	2.3
20-499	1,046	74	77,741	40.4
500-999	21	638	13,395	7.0
1,000-4,999	7	1,504	10,529	5.5
5,000-14,999	0		. .	. .
15,000+	2	43,027	86,055	44.8
Total	1,526		192,118	100.0

study specifications. In these cases, a new owner was drawn from the rolls.

Figure 1 shows the location of the ownerships sampled.

Each owner (or his representative) whose name was drawn was per-

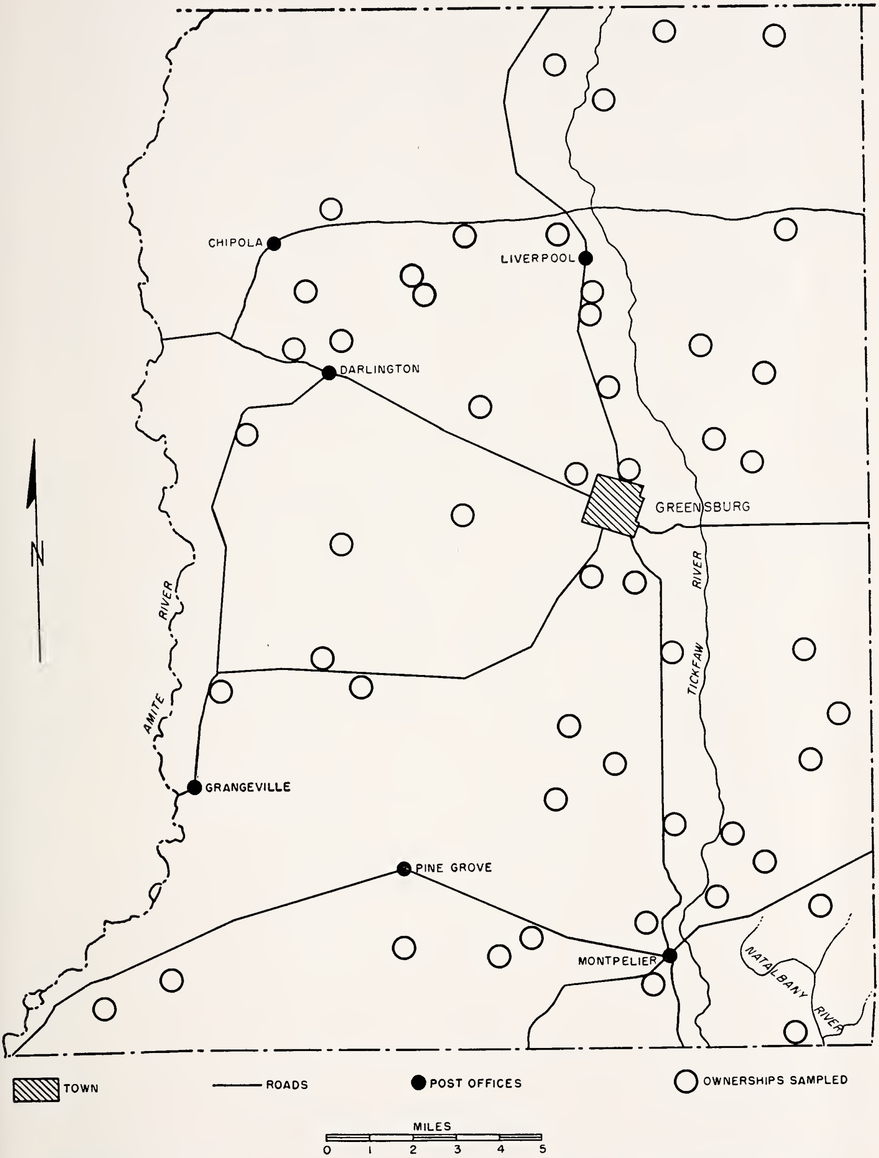


FIGURE 1.—St. Helena Parish, Showing Location of Ownerships Sampled.

TABLE 2.—Ownership Factors Studied

Ownership factor	Owners	
	Total	Practicing forestry
	No.	*No.*
Age		
0 to 29 years	4	1
30 to 49 years	13	4
50 to 64 years	19	3
Over 65 years	14	4
Race		
White	40	10
Colored	10	2
Occupation group		
Dairy farmer	9	1
Cotton farmer	6	1
Baton Rouge wage earner	9	1
Local wage earner	15	4
Retired farmer	5	0
Retired non-farmer	3	3
Self-employed (businessman)	3	2
Education		
Elementary (1 through 8 years)	25	3
Secondary (9 through 12 years)	17	4
College (1 year or more)	8	5
Size of ownership		
20 to 59 acres of forest land	28	5
60 to 249 acres of forest land	18	5
250 to 499 acres of forest land	4	2
Residence		
Residing on tract	36	10
Non-resident	14	2
Method of acquisition		
Inheritance	12	2
Purchase	31	8
Both inheritance and purchase	7	2
Primary use of the tract		
Timber growing	14	4
Timber liquidation	3	0
Grazing	19	6
Recreation	2	0
Agriculture	12	2
Length of ownership (year acquired)		
Since 1951	10	5
1941 thru 1950	14	1
1930 thru 1940	8	1
Prior to 1930	18	5

sonally interviewed. A questionnaire (Appendix) was used to provide information on:

The owner's age, race, occupation, educational level.

Distance of tract from owner's residence.

How the property was acquired, length of tenure, and primary use.

Whether or not the owner was practicing forestry. (He was considered an active forest manager if he had, singly or in combination, marked timber prior to sale, installed fire lanes, girdled or poisoned undesirable hardwoods, planted trees, or fenced to control grazing.)

The influences that persuaded the owner to practice forestry and the source of any management assistance.

Owner's reasons for not practicing forestry.

With permission of the owner, a field check by point-sampling was made of his timber resources. The number of sample points varied with the size of the tract:

10 sample points for 20-59 acres of forest land.

20 points for 60-249 acres of forest land.

30 points for 250-499 acres of forest land.

In addition, square milacre plots were taken at each sample point to assess stocking. A milacre falling on a pine site was considered stocked if it contained any pines, regardless of size, or if any part of the quadrat was overtopped by a pine larger than 3 inches in diameter at breast height (d.b.h.). For hardwood sites the principle was the same, but cull trees or undesirable species were not counted.

Factors pertaining to the owner and his timber were analyzed statistically. Table 2 lists the total number of owners in the various categories tested, and also the number practicing forestry. Multiple regression analysis, incorporating "dummy variables" (*12*), was used to test for significant differences between categories when compared on the basis of whether or not the owner was practicing forestry. A chi-square analysis was made of the factors of ownership size and education, since the dummy-variable technique did not conclusively establish their significance. The refusal of one or more owners to answer all questions or to permit inspection of their timber accounts for minor differences in tabular totals.

RESULTS

Twelve landowners, or 24 percent of the 51 individuals interviewed, were practicing some form of positive forest management. The sample suggests that over 240 landowners in the parish are managers.

Among occupational groups, the local wage earners had the greatest proportion of forest managers, and the retired farmers the least. Both

TABLE 3.—Forestry Practices Used by Landowners

Practice	Owners using practice
	Number
Marketing	7
Girdling or poisoning	6
Planting	3
Firelane installation	2
Fencing to control grazing	1
Total	19

of these departures from the mean were statistically significant. Owners who had attended college were managing significantly more often than those with grammar school education.

The categories of retired non-farmers, resident owners, graziers, and owners whose tenure dated from 1951 included sufficient forest managers to approach, but not quite cross, the threshold of statistical significance. Commuters to metropolitan jobs, non-resident owners, and recreationists had the fewest managers, but the deviation from the average was not quite significant.

Half of the 12 managers had developed enough acumen to mark their timber before selling it. A goodly number had been convinced of the benefits of eliminating undesirable trees. A few planted seedlings, installed firelanes, or fenced out grazing animals (Table 3). All but two owners had either sought assistance from or been contacted by conservation workers (Table 4), all except one of whom were professional foresters.

Motivations.—Why do some manage and others not? Nearly half of the owners who were not managing asserted that they had a better use for their land than growing timber. Many also lacked an adequate concept of what forestry is or what it might bring them. Emergency needs for money had influenced 12 owners to liquidate their growing stock.

TABLE 4.—Sources of Technical Assistance

Source	Times Used
	Number
Soil Conservation Service	3
Wood-using firm	3
Louisiana Forestry Commission	2
Agricultural Extension Service forester	2
Consulting forester	2
County agent	1
Total	13

These and other reasons are cited in Table 5. Many non-managers offered more than one reason—the table contains 64 reasons for 39 owners.

Though farmers are usually considered to have the best opportunity for enlightened stewardship, those interviewed generally lacked interest in forest management. Cotton farmers appeared to be living at a bare subsistence level. Dairy farmers seemed to enjoy a much higher economic level, as indicated by the condition of their properties, but regardless of economic condition the farmers judged their present land use far superior to that of including timber growing as an alternative.

Owners who resided on their properties managed no better than absentees. The comparison is clouded, however, by the fact that the residents included many Baton Rouge wage earners, who are probably only one step removed from urban living. Other studies have found that residence facilitates management (*4*, *16*).

Also in some contrast to earlier research (*9*, *13*, *16*) is the lack of correlation between the owner's age and his forest practice. This anomaly is perhaps explainable. The retired farmers, practically none of whom were forest managers, comprised 43 percent of those over 65 years of age. These men did not fit the commonly accepted idea of a retired farmer. Physical infirmity, not choice, had forced inactivity upon them. Most depended upon public old-age assistance. Their forest land was no more dilapidated than the rest of their properties.

The retired non-farmers, by contrast, had apparently been able to provide themselves with a competence. Though the group was small, all members of it were practicing forestry in pursuance of deliberate plans for supplemental retirement income.

Public and private foresters have long believed in the demonstration value of good management. Two sample owners gave credit to

TABLE 5.—Respondents' Reasons for Not Practicing Forestry

Reason	Owners
	Number
Has better use for the land	16
Lacks understanding of forestry alternative	12
Emergency money needs	12
Interested, but has not yet taken initiative	7
Takes too long for returns	5
Lives too far from land	3
Land involved in estate disputes	2
Lacks timber marketing knowledge	2
Can grow timber without management	2
Retaining old family place "as is" for sentimental reasons	1
Wants to sell land	1
Too risky	1

TABLE 6.—Timber Resources of Owners Sampled

			Proportion of milacres stocked			Volume per acre		
Management status	Owners	Tract size	To pine	To hardwood	Un-stocked	Pine	Hardwood	Total
	Number	*Acres*	*Percent*	*Percent*	*Percent*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
Managed tracts								
Pine	11	125	70	10	20	566	191	757
Hardwood	0	. . .	. .	. .	. .	. . .	. . .	. . .
Unmanaged tracts								
Pine	33	66	48	32	20	331	336	667
Hardwood	6	123	21	71	8	68	422	488

exemplary management on nearby industrial ownerships for their own forestry practices.

Half of the owners who had acquired their tracts since 1951 were practicing forestry—in contrast to 21 percent of those with longer tenure (*2*). Though none of the recent owners had purchased their land specifically to grow timber, they had acquired it in times of relatively high prices and thus found themselves under pressure to make their woodlands pay. Most of these owners were under 40 years of age, and had completed high school. The local wage earners who were practicing forestry were motivated partly by the availability of technical forestry assistance and subsidies.

Owners' statements as to their management practices were generally borne out by the reconnaissance of their forests. The managed upland tracts had almost twice as much pine volume per acre as the unmanaged and were much better stocked with pine reproduction (Table 6). Unless remedial measures are taken to lessen hardwood competition, pine stocking on the unmanaged tracts will decline.

The managers not only had more desirable timber than the non-managers but also held larger acreages. The interviews revealed that most managers had begun their program during the last ten years, yet the differences between the managed and unmanaged tracts appear too large to have been entirely achieved in a decade. Having a reasonable stand of timber is in itself a motivation toward management (*8*). It is likely that those St. Helena owners who have improved their opportunities began with something more than the average depleted stand.

CONCLUSIONS

The realization that forestry can be made to pay has led some 240 small-tract owners in St. Helena Parish to begin managing their stands. The trend to management is recent. It can be largely attributed to the intensified forestry promotion, the increasing number of examples of good management, and the free services that have developed in the last decade.

This study reinforces others in indicating that landowners who undertake management programs do so on tracts of above-average size and stocking. It also appeared to the interviewers that owners who were making a start in forestry had generally more financial resources than the non-managers. Many non-managers either were unacquainted with the potentialities of forestry, or thought they had a superior use for their forest land.

These findings offer some suggestions for public and private agencies interested in further increasing the number of small-tract managers in the parish. First, appraisals of alternative land uses should be made to help landowners compare forestry with other enterprises. Those who have not even considered forestry should be given an understanding of what their woodlands might yield for them. Finally, depleted tracts require a substantial investment in remedial measures before they can become productive. Some private or public assistance, in addition to what is already available, may be needed before owners with very limited resources will begin managing.

LITERATURE CITED

1. Coulter, C. H., Malsberger, H. J., Baggenstoss, H. E., and Craig, J. W. 1957. Panel discussion: the small forest landowner—keystone and enigma in forestry. Soc. Amer. Foresters Proc. 1956: 159-162.
2. Folweiler, A. D., and Vaux, H. J. 1944. Private forest land ownership and management in the loblolly-shortleaf type of Louisiana. Jour. Forestry 42: 783-790.
3. Hocker, Harold W., Jr. 1955. Climatological summaries for selected stations in and near the southern pine region, 1921-1950. U. S. Forest Serv., Southeast. Forest Expt. Sta. Paper 56, 11 pp., illus.
4. James, L. M., Hoffman, W. P., and Payne, Monty A. 1951. Private forest landownership and management in central Mississippi. Miss. Agr. Expt. Sta. Tech. Bul. 33, 38 pp., illus.
5. Korstian, Clarence F. 1944. Forestry on private lands in the United States. Duke Univ. School Forestry Bul. 8, 234 pp., illus.
6. Louisiana Forestry Commission. 1955. Forest land ownership in Louisiana. La. Forestry Comm. Bul. 5, p. 60.
7. McArdle, R. E. 1947. Technical assistance for private forest owners. Jour. Forestry 45: 36-39.
8. Mignery, A. L. 1956. Factors affecting small-woodland management in Nacogdoches county, Texas. Jour. Forestry 54: 102-105.
9. Pleasonton, A. 1957. Upland hardwood management appeals to west Tennesseans. South. Lumberman 195 (2441): 108-110, illus.
10. Snedecor, G. W. 1956. Statistical methods. Ed. 5, 534 pp. illus. Ames, Iowa.
11. Southern Forest Experiment Station. 1955. Forests of Louisiana, 1953-54. U. S. Forest Serv., South. Forest Expt. Sta. Forest Survey Release 75, pp. 5, 31, illus.
12. Suits, D. B. 1957. Use of dummy variables in regression equations. Jour. Amer. Statis. Assoc. 52 (280): 548-551.
13. Tennessee Valley Authority. 1956. Infuence of woodland and owner characteristics on forest management. TVA Report 217-56, 38 pp., illus.
14. U. S. Forest Service. 1958. Timber resources for America's future. U. S. Dept. Agr. Forest Resource Report 14, 713 pp., illus.
15. U. S. Weather Bureau. 1955. Climatic summary of the United States—supplement for 1931 through 1952. Sec. 11-14, Louisiana, p. 20.
16. Yoho, James C., James, L. M., and Quinney, D. N. 1957. Private forest landownership and management in the northern half of Michigan's Lower Peninsula. Mich. Agr. Expt. Sta. Tech. Bul. 261, 56 pp., illus.

APPENDIX

Questionnaire

LS 40-810
Schedule I

1. Sample number ______________________________
2. Location of tract: Parish ____________ T ________ R ________ S ________
3. Name ____
4. Address ______________________________ 5. Age: ________
6. Sex ______ 7. Race __________ 8. Educational level ______________
9. Occupation:
    (a) __________Forest industry
        __________lumber
        __________pulp
        __________other (specify) ____________________
    (b) __________Non-forest business
        __________financial
        __________minerals
        __________railroad
        __________other (specify) ____________________
    (c) __________Farmer
        __________dairy
        __________beef
        __________strawberry
        __________other (specify) ____________________
    (d) __________ Professional (specify) ____________________
    (e) __________ Other (wage earner, housewife, etc.) (Specify) __________
10. Land owned in parish: ______________ total ______________ forest
11. Distance of sample tract from owner's residence:
        __________resident
        __________1-10 miles
        __________11-50
        __________51-100
        __________101-200
        __________201 and up
12. Method of acquisition:
    (a) ________purchase ________inheritance ________ gift ________foreclosure
    (b) ________mortgaged ________ not mortgaged
13. Use of sample tract:
        __________timber growing
        __________timber liquidation
        __________grazing
        __________recreation
        __________residence
        __________minerals
        __________agriculture
        __________investment
        __________strawberry mulch
        __________other (specify) ________
14. Length of tenure (years in present ownership):
        __________less than 1 year
        __________1951 to 1956
        __________1946 to 1950
        __________1941-1945
        __________1930-1940
        __________prior to 1930

15. (a) Does owner practice forestry? ____________ yes ____________ no

(b) If yes, why (enumerate): ______________________________

____

(c) If no, why (enumerate):

____________lack of market knowledge
____________lack of understanding of the forestry alternative
____________too risky
____________taxes too high
____________not enough profit
____________takes too long
____________alternative land use better
____________other (specify) ______________________________

Remarks: ____

____

____

16. Management assistance data:

(a) Owner's knowledge of forestry assistance programs:

Sources known available	Sources utilized	
____________	____________	LFC
____________	____________	Extension Service foresters
____________	____________	County agents
____________	____________	SCS
____________	____________	ACP
____________	____________	FFA
____________	____________	4-H
____________	____________	Soil Bank Program
____________	____________	Wood-using corporations
____________	____________	Consulting firms (fee basis)
____________	____________	Consulting firms (lease)
____________	____________	Others (specify) ____________________

____

(b) Type of service utilized:

Type	No. times utilized	
____________	____________	Marking
____________	____________	Demonstrations attended
____________	____________	Planting stock furnished
____________	____________	Planting aid
____________	____________	TSI aid
____________	____________	Protection aid (fire)
____________	____________	Protection aid (insects & disease)
____________	____________	Marketing advice
____________	____________	Summer camps
____________	____________	Complete management service (fee basis)
____________	____________	Complete management service (lease)
____________	____________	Other (specify) ____________________

____

(c) Have any of above services been primarily responsible for changing owner's attitude to forest management? ________yes ________no
If yes, specify: ____

(d) If owner has utilized any of above services, is he planning to use the same services again? ________yes ________no

17. Data if management assistance has not been utilized:

(a) Was management assistance sought but not located? ________yes ________no

(b) Management assistance not sought because:
________Owner thinks he can apply forest management without assistance
________Immediate needs for cash money have prevented owner from practicing forest management even though he is interested

18. Remarks:

Form For Forest Inventory

LS 40-810
Schedule II

1. Sample number ____________________

2. Name ____

3. Pulpwood (under 10" dbh):

No. of logs	Tree tally		Cu. vol. factor	Cubic volume		Cords	
	Pine	Hardwood		Pine	Hardwood	Pine	Hardwood
0			0				
½			5				
1			11				
1½			16				
2			21				
2½			26				
3			30				
3½			34				
4			37				
Total							

4. Sawlogs (over 10" dbh):

No. of logs	Tree tally		Cu. vol. factor	Cubic volume		Bd. ft. vol. factor (Int. ¼")	Bd. ft. vol. (Int. ¼")	
	Pine	Hardwood		Pine	Hardwood		Pine	Hardwood
0			0			0		
½			5			3		
1			11			7		
1½			16			10		
2			21			13		
2½			26			15		
3			30			18		
3½			34			20		
4			37			23		
Total								

5. Recent cuttings (1/5-acre plots):

Stump diam.	PINE					HARDWOOD				
	No. trees	Stump height	B A	Volume (cu. ft.)	Volume (cords)	No. trees	Stump height	B A	Volume (cu. ft.)	Volume (cords)
6										
8										
Pulp- wood total										
					Bd. ft. (Int ¼)					Bd. ft. (Int ¼)
10										
12										
14										
16										
18										
20										
22										
24										
26										
28										
30										
Saw- log total										

6. Stocking percent

No. of plots stocked	
Pine	
Good hdwd.	

Stocking = tree on milacre plot if under 3" dbh or overtopping plot if over 3" dbh.

7. Miscellaneous:
(a) Area fenced to prevent grazing? ____________yes ____________no
(b) Firelanes plowed? ____________yes ____________no
(c) Area planted? ____________yes ____________no
If yes, no. of acres planted ________________
(d) Interval before next cut ____________________ years

8. Remarks—general description of condition of land:

THE LOUISIANA FOREST INDUSTRY

Its Economic Importance and Growth

c. 7
936

Bulletin No. 521

Agricultural Experiment Station
Charles W. Upp, Director

March 1959
Louisiana State University
and Agricultural and
Mechanical College

SUMMARY TABLE

		1953	1957	Change
I.	General			
	Wood mfg. establishments, number	1,181	1,142	— 39
	Employment, number of workers	41,246	36,502	— 4,744
	Annual payroll, million dollars	117	131	+ 14
	Value annual output, million dollars	507	735	+ 228
	Severance tax revenue, thousand dollars	583	660	+ 77
II.	Cutting			
	Sawtimber, million board feet	880	721	— 159
	Pulpwood, thousand cords	1,357	1,412	+ 55
III.	Replacement			
	Growth rate in excess of cutting rate, per cent	96	114	+ 18
	Seedlings planted, millions	60	80	+ 20

CONTENTS

Summary Table 2
Proportion of Louisiana Acreage Devoted to Forests 5
Forest Resources 7
Rate of Severance for Sawtimber and Pulpwood 8
Rate of Replacement 10
Employment in Wood Manufacturing Industries 13
Recent Employment Trends in Forest Industries 16
The Value of Forest Products 19

ACKNOWLEDGMENTS

The author wishes to acknowledge the use of data provided by the Louisiana State University School of Forestry, the Southern Forest Experiment Station of the United States Forest Service, the Louisiana State Forestry Commission, the Division of Employment Security of the Louisiana State Department of Labor and the Louisiana State Department of Commerce and Industry. Photographs were provided by the Louisiana State Forestry Commission.

THE LOUISIANA FOREST INDUSTRY

Its Economic Importance and Growth

F. L. Corty[1]

Proportion of Louisiana Acreage Devoted to Forests

Slightly more than half (55.8%) of the land in Louisiana is classified as forest land. Less than 1 per cent (0.6%) is considered non-commercial forest.[2]

Forest land is found in every parish of the state but the proportion of land devoted to forest varies considerably among parishes. It ranges from less than 1 per cent in Cameron Parish, bordering the Gulf coast, to slightly more than 90 per cent in Winn Parish, just north of Alexandria. Fifteen of the 64 parishes are more than 75 per cent forested. Thirteen of these form a ham-shaped area near the center of the state bounded by Lake Charles, Mansfield, Ruston and Vidalia. More than half (34) of the parishes have more than 60 per cent of their land area in forest (Figure 1).

More Louisiana land is devoted to forestry than to farming. In fact the area of forest land exceeds crop and pasture land by about five million acres.

Woodlands may be classified into two broad categories—softwoods, consisting of the numerous pine varieties, and hardwoods, which include the oak, hickory, gum, elm, ash and cottonwood types.

Hardwoods dominate about half of the forest area in the state. They are localized primarily in the delta regions and along waterways. A broad belt of bottomland hardwoods extends along the Mississippi River from the northern boundary of the state to New

---

[1] Assistant Professor, Department of Agricultural Economics.

[2] Forest land includes areas of more than one acre, not less than 120 feet in width, and at least 10 per cent stocked with trees which are capable of producing timber or other wood products. A less-than-10 per cent stocking would still be classed as forest land if trees were removed but land remained for tree production. Land is classified as non-commercial when it has been withdrawn from timber production and utilized for parks, monuments or other special uses, and also when it is incapable of yielding wood products or is physically inaccessible so that wood products are not economically available.

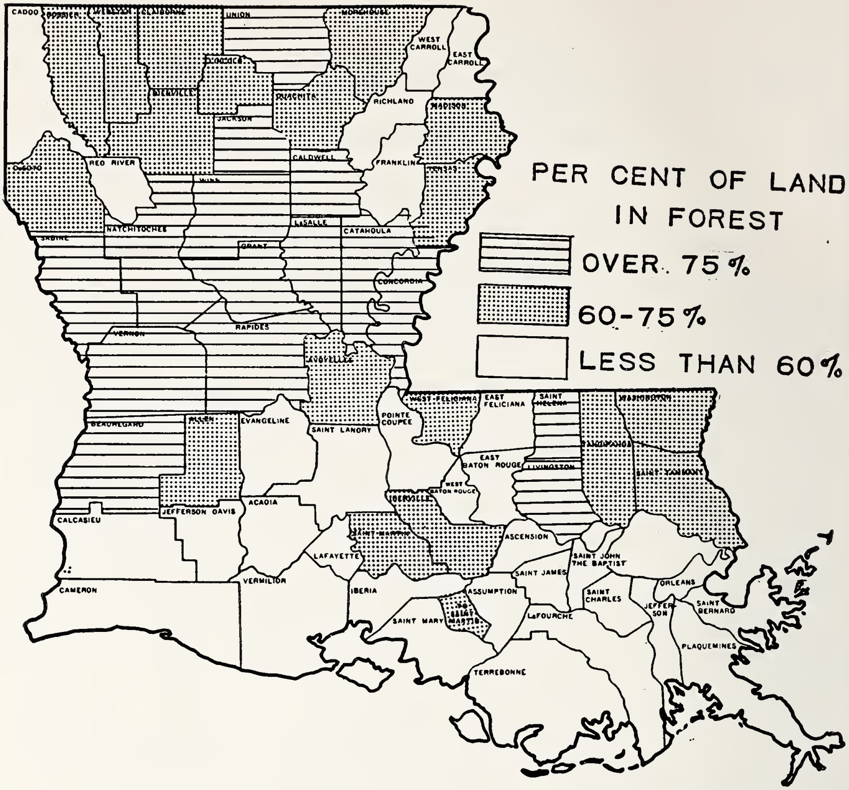


FIGURE 1.—Proportion of parish area in forest, 1953-54.

Orleans, thus separating two softwood regions. One softwood region is a six-parish area in the Florida Parishes district and the other is a 20-parish area in the western and northwestern part of the state (Figure 2).

Forest lands of Louisiana are owned by 111,654 persons, with average holdings of 144 acres per owner.[3] This is more than twice as large as the national average of 66 acres.

About 5 per cent of the forest land is owned by government agencies. The Federal government owns a little more than 3 per cent, and slightly less than 2 per cent is held by state, parish and municipal governments.

---

[3] *Louisiana Forest Facts,* 1958 Edition. The Louisiana Forest Industry Committee, 1033 National Bank of Commerce Building, New Orleans, Louisiana. p 4.

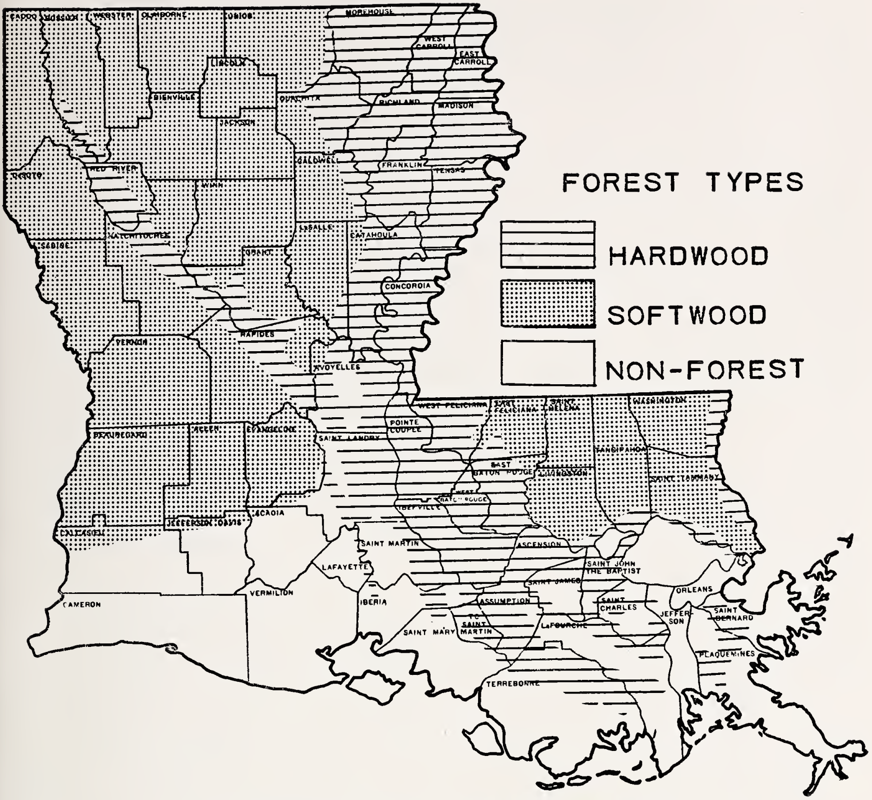


FIGURE 2.—Forest types in Louisiana.

Of the 95 per cent owned privately, only 20 per cent is in farm acreage, 36 per cent is owned by industrial groups, and 39 per cent by other private individuals.

Forest Resources

An official survey of Louisiana forest resources was made by the United States Forest Service in 1953-54.[4] The existing volume of sawtimber was then estimated to be about 45.4 billion board feet. Sawtimber includes softwoods 9 or more inches in diameter and hardwoods 11 or more inches.

Two-fifths of the softwood acreage and half the hardwood acreage was in sawtimber stands which constituted 46 per cent of Louisiana's commercial forest acreage.

---

[4] *Forests of Louisiana, 1953-54.* Forest Survey Release 75, Southern Forest Experiment Station, New Orleans, Louisiana, April 1955.

About half of the commercial forest area was considered well stocked; that is, the woodland contained at least 70 per cent of the number of trees required to fully utilize the available growing space.

At the time of the survey the sawtimber stands included 20.3 million board feet of softwood and 25.1 million board feet of hardwood. A breakdown in terms of diameter classes revealed that 50 per cent of the volume of softwood and hardwood sawtimber consisted of trees 14-18 inches in diameter. One-third of the softwood volume was in trees 10-12 inches in diameter but only one-seventh of the hardwood volume was in this size group. On the other hand, a little over a third of the volume in the 20-inches-or-more diameter class was hardwood and about one-sixth softwood (Table 1).

TABLE 1.—Volume Composition of Sawtimber Stands in Louisiana, 1953-54

Diameter Breast High	Softwoods	Hardwoods
(Inches)	(Per Cent of Volume)	
10 - 12	33	14
14 - 18	51	50
20 and up	16	36
Total	100	100

The 1953-54 inventory of forest growing stock, which includes all trees 5 inches or more in diameter, showed a total volume of 12.1 billion cubic feet. Net annual growth was computed to be about 716 million cubic feet. The timber cut in 1953 was 366 million cubic feet.[5] Thus, the rate of growth was exceeding the rate of cut by 96 per cent.

Rate of Severance for Sawtimber and Pulpwood

In the past five years (1953-57) sawtimber cut in the state has averaged 851 million board feet per year. The greatest cut occurred in 1956 when about 956 million board feet were harvested. In 1957 the cut dropped to 721 million, the lowest of the five-year period (Figure 3).

A tree 16 inches in diameter and 75 feet tall will make approximately 250 board feet of lumber. On this basis, it is estimated that in 1957 about 2,886,000 trees were cut for sawtimber, an average of 7,907 per day, or 330 trees every hour.

---

[5] *Ibid.*, pp. 12-13.

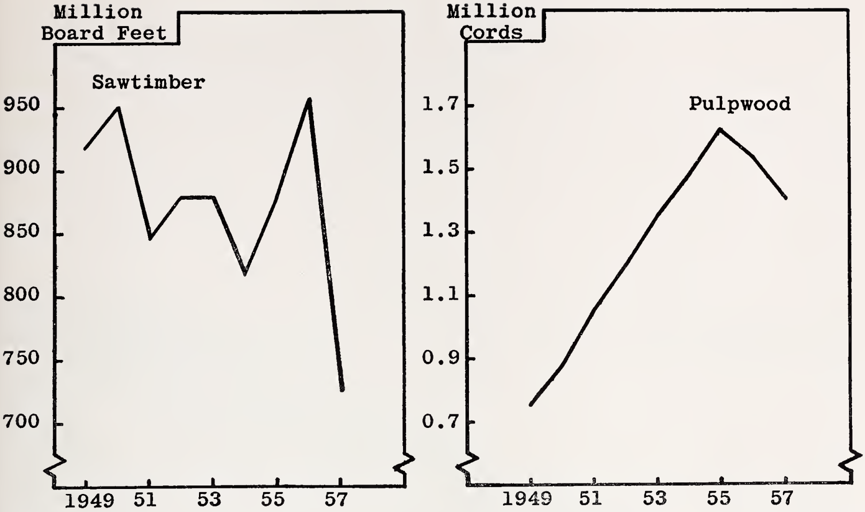


FIGURE 3.—Removal of sawtimber and pulpwood from Louisiana forests, 1949-57.

Lumber production in Louisiana has continued to be about 2 or 3 per cent of total production in the United States and pulpwood production about 4 to 5 per cent. Although lumber production in the 1950's dropped below that of the 1940's, annual pulpwood production increased from less than a million cords in the previous decade to about 1.5 million during the current 10-year period.

The peak of pulpwood production in Louisiana was reached in 1955. Production decreased in 1956 and 1957. The average production for the five-year period 1953-57 was almost 1.5 million cords. When board feet of timber and cords of pulpwood are converted to cubic feet it appears that the average five-year volume removed for sawtimber exceeded that removed for pulpwood by almost 20 million cubic feet.[6]

It is estimated that eight trees, 10 inches in diameter and 40 feet tall, are required to make one cord of pulpwood. Thus, in 1957, about 11,299,328 trees were cut for pulp, an average of 30,957 per day, or about 1,290 trees every hour.

The total harvest of sawtimber and pulpwood was calculated to be about 217 million cubic feet in 1957, compared to 237 million cubic feet in 1953. This drop of 20 million cubic feet is at-

---

[6] Conversion factors used here were:
One cord of pulpwood = 75 cubic feet of solid wood.
6.5 board feet of sawtimber = 1 cubic foot of solid wood.

Stacks of lumber for the building trades.

tributed to the reduced cutting of sawtimber, which more than offset the increase in pulp cutting.

Rate of Replacement

The survey of Louisiana forests conducted by the United States Forest Service indicated that timber, both pine and hardwood, is growing about twice as fast as it is being cut. Large sawtimber trees are fewer in number but the total sawtimber supply, as well as the total growing stock, is greater now than it was 20 years ago. In the 1930's the rate of cut exceeded the rate of growth, and major concern was expressed over the gradual depletion of this natural resource. By mid-1940, however, the rate of cut dropped below the rate of replacement, and Louisiana's timber supply now promises to build up very rapidly. Favorable growing conditions have helped Louisiana become one of the leading southern states in volume of timber per forest acre.

Annual net growth of growing stock (trees over five inches in diameter) averages 45 cubic feet per acre (46 cubic feet for softwood types and 43 cubic feet for the hardwoods). In sawtimber of all stand sizes, the annual net growth averages 175 board feet, or 27 cubic feet, per acre.[7]

Several factors have helped to reverse the trend in which the rate of cutting exceeded the rate of growth or replacement. Since mid-1940 the annual cut of sawtimber has been gradually decreasing; the slower-growing hardwoods are being replaced by faster-growing softwoods; more and more farm acreage is being converted to woodland; and better fire protection has cut down losses.

This decade has also given rise to a tremendous interest in reforestation and improved forest management, which in large part can be attributed to the Soil Bank Conservation Reserve Program. In this program the landowner who meets certain requirements receives an initial payment for putting land in trees and then receives annual rental payments for the duration of a 10-year contract. The older Agricultural Conservation Program also continues to encourage reforestation through somewhat smaller payments.

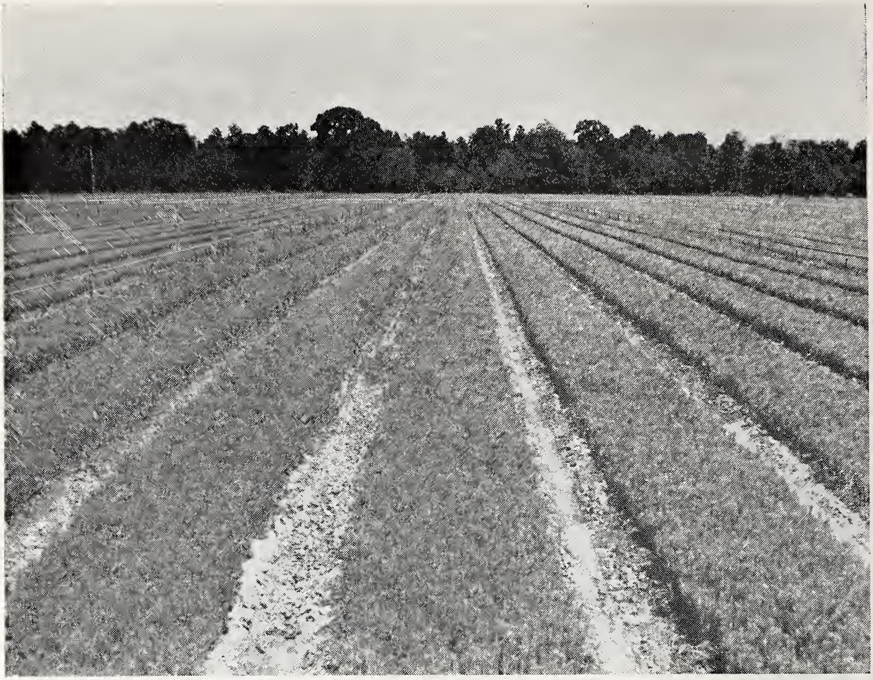
Promotional campaigns on the part of various forestry associations and industrial firms have done wonders to instill interest in conservation and reforestation—influencing not only the individual landowners but also civic groups and legislative bodies.

Tree planting in Louisiana is taking place at an astounding rate. Propagation by direct seeding is not practiced extensively, although in 1957-58 an industrial concern seeded about 1,200 acres by airplane and in 1958-59 plans to seed an additional 18,000 acres. Planting of seedlings is by far the more popular technique.

Seedlings are supplied by seven forest tree nurseries in Louisiana. Three are state owned, one is a Federal nursery and three are owned by wood-using industries. In 1953, about 60 million seedlings were produced for reforestation purposes. By the spring of 1958 seedling production had almost doubled. It is estimated that more than 170 million will be available for the 1958-59 planting season (Figure 4). The state nurseries alone plan to supply 125 million. More than a third of these will be used in conjunction with the Conservation Reserve Program of the Soil Bank.

---

[7] *Op. Cit., Forests of Louisiana,* p. 12.



One of the three state nurseries which helped to produce more than 100 million seedlings for the 1958-59 planting season, Oberlin, La.

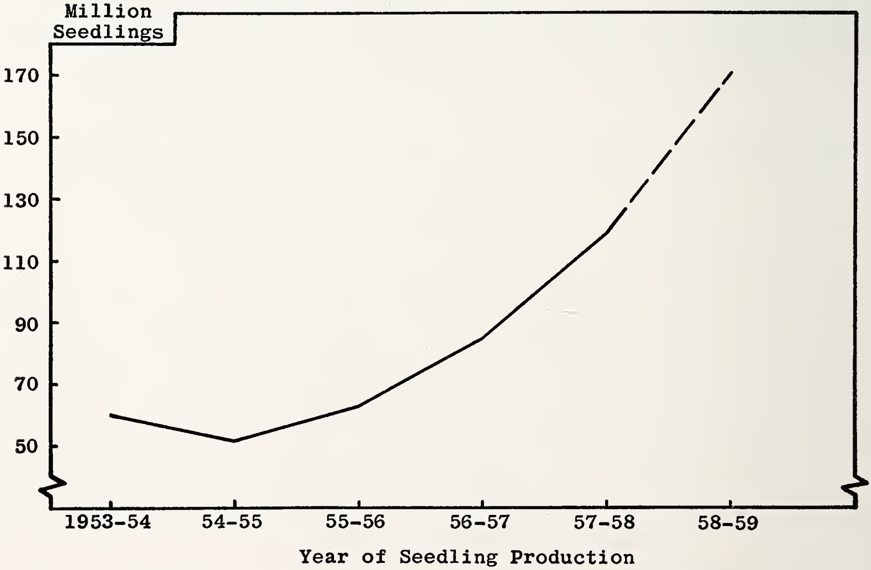


FIGURE 4.—Seedling production in Louisiana, 1953-58.

Not all of the seedlings produced in Louisiana are planted in the state. Only about one-fifth of the Federal nursery production is used in Louisiana. The other four-fifths is used in several southern states extending from Texas to Florida. One of the industrial nurseries also indicated that 500,000 of its 5,500,000 production for 1959 will be used outside the state. Information received from the nurseries indicates that about 145 million pine seedlings will be planted in Louisiana in the 1958-59 season. Since seedlings are usually planted at the rate of about 1,000 trees per acre, it is reasonable to assume that at least 145,000 acres are scheduled for tree planting.

Another program which reflects the growing interest in forest lands is the Tree Farm Program. It is sponsored nationally by the American Forest Products Industries, Inc. and administered in Louisiana by the Louisiana Forestry Association. This organization gives special recognition to a forest landowner who demonstrates his intent or ability to manage his timber wisely and to protect it from fire and other destructive agencies.

A tree farm is a privately-owned forest area of any size that is being used by the owner for the continuous production of commercial forest products and for related uses, including conservation of water, propagation of wildlife, and recreation. A qualified tree farmer receives a certificate and a neat, diamond-shaped road sign signifying membership in the American Tree Farm System.

The Tree Farm Program was introduced in Louisiana in October 1951. By 1955 there were 154 tree farms embracing 1,807,511 acres of woodland. By September 1, 1958, there were 574 Tree Farm members, who owned 3,121,389 acres, almost one-fifth of Louisiana's forest land acreage.

Employment in Wood Manufacturing Industries

Wood using industries in Louisiana provide annual employment for 40,000 to 45,000 people, making up about one-fourth of the manufacturing employment in the state.[8] Annual wages for this group totals more than $130 million or one-fifth of Louisiana's manufacturing payroll.[9] Products resulting directly from the wood industries in 1957 had an estimated market value of $730 million, or about one-sixth of the value of the state's entire manufacturing output.[10]

---

[8] Based on data provided by the Division of Employment Security, Louisiana State Department of Labor. The number of employees is reported quarterly by establishments having four or more workers covered by the Louisiana Employment Security Law. Approximately 10 per cent of the workers in wood manufacturing industries do not come under the Employment Security Law About 152,000 persons were engaged in manufacturing industries in 1957.

The importance of the forest industry looms even larger when it is recognized that the above employment figures apply only to the 1,100 manufacturing establishments employing four or more persons. Smaller operations of less than four employees are not included, nor are those engaged in production of trees or management of woodlands. There are approximately 20 firms employing about 200 persons in production of forest trees. An additional 100 professional foresters are employed by public agencies to carry on education, extension and research. It is also necessary to consider the 112,000 owners of forest land, many of them farmers, who rely upon timber stands as an additional source of income.

Utility poles from Louisiana forests, Urania, La.

---

[9] Based on *Fourth Quarter Report,* Division of Employment Security, Louisiana State Department of Labor, 1957.

[10] *Look at Louisiana Industry,* Louisiana State Department of Commerce and Industry, 1957 data.

Forest industries may be divided into four categories according to type of product and activity. They are: (1) lumber and wood products, (2) paper and allied products, (3) furniture and fixtures, and (4) gum and wood chemicals.

Lumber and wood products industries perform cutting, logging and milling operations resulting in products such as lumber, plywood, shingles, pallets, poles, crossties, boxes and other basic wood materials. About 55 per cent of the workers employed in manufacturing forest products are included in this category (Table 2).

TABLE 2.—Number of Establishments, Employment and Wages in Louisiana Forest Industries, 1957

Industry Group	Number of Establishments	Number of Employees	Wages
Lumber and Wood Products	1,061	20,191	$ 53,244,505
Paper and Allied Products*	46	14,446	70,773,407
Furniture and Fixtures†	27	958	2,951,896
Gum and Wood Chemicals	9	907	3,894,084
Total	1,143	36,502	$130,863,892

*Corrected to exclude non-woodpulp paper making establishments.
†Furniture establishments specializing in fabrics, plastics and metals are omitted.

Paper and allied products industries manufacture woodpulp, convert pulp into many kinds of paper or paperboard and make paper bags, boxes, cards, envelopes and coated paper. Daily pulp producing capacity of Louisiana mills is 5,055 tons.[11] About 40 per cent of the forest products manufacturing employees are engaged in this phase of the industry.

Furniture and fixtures industries include those firms engaged primarily in the manufacture of wooden furniture and wooden cases and cabinets. Only 2.6 per cent of the forest products workers are employed in this phase of the industry.

Gum and wood chemical plants employ about the same number of men as the furniture and fixtures group. The work in this category consists of processing resinous stumps to produce distilla-

---

[11] Hayes, Ralph W., *Pulpwood Production and Use in Louisiana.* La. Agr. Exp. Sta. Bulletin No. 508, June 1956, p. 6.

A Louisiana paper mill. Louisiana ranks fourth in pulp production capacity, exceeded only by Washington, Georgia and Florida.

tion products such as wood turpentine, pine oils, pitch, tar, creosote and wood alcohol.

Recent Employment Trends in Forest Industries[12]

Employment in forest industries reached a peak of 53,000 in 1947-48, primarily as a result of an expanded building program following World War II. In 1951, during the Korean conflict, employment stood at about 47,000, but in the past five years there has been a continuous decline so that by mid-1958 employment had dropped to about 34,000.

The most conspicuous reduction occurred in the lumber and wood products group. Employment dropped from about 24,600 in 1953 to about 18,000 in the summer of 1958 (Figure 5).

In paper and allied products, employment was fairly stable throughout the period; that is, between 14,000 and 15,000.

The number employed in the manufacture of wooden furniture and fixtures dropped from about 1,150 in 1953 to about 900

---

[12] Based on employment covered by Louisiana Employment Security Law, which does not include establishments with less than four employees.

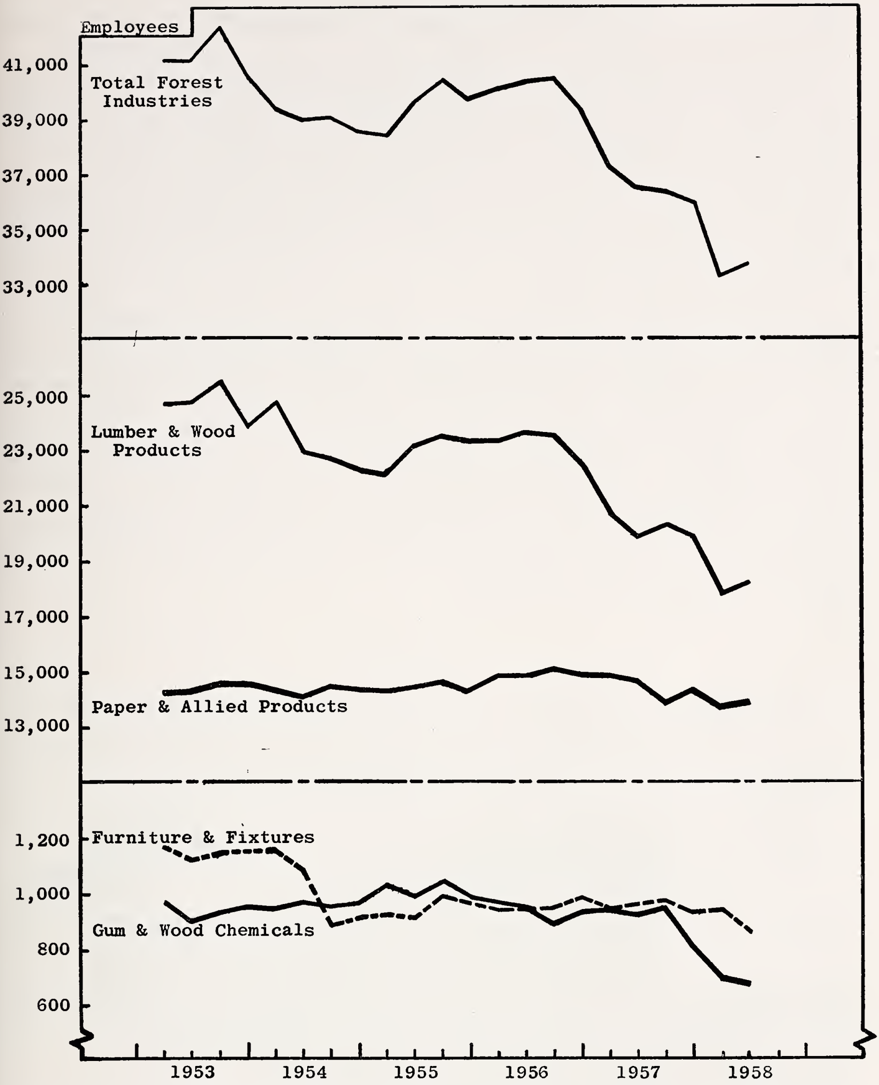


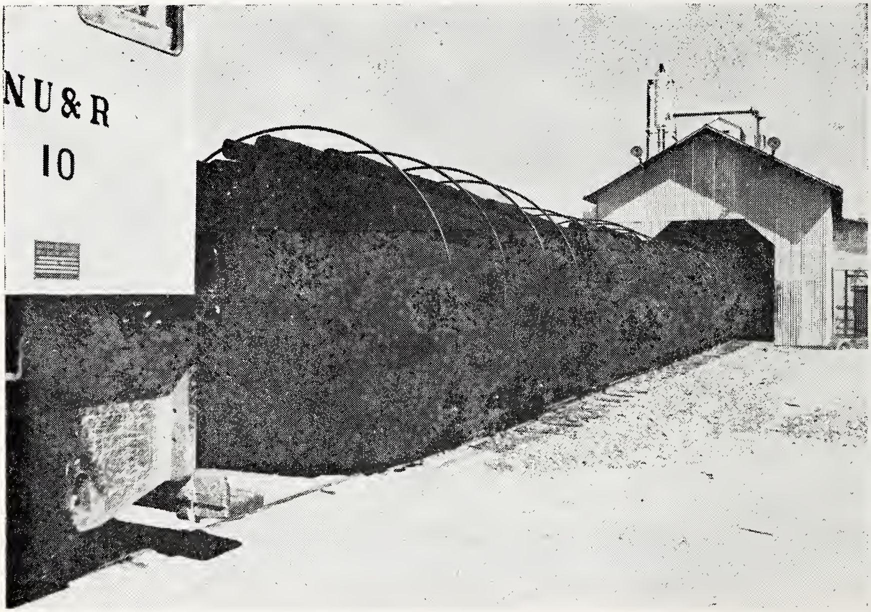
FIGURE 5.—Employment trends in Louisiana forest industries, 1953-1958.

in 1958. Workers in gum and wood chemicals numbered almost 1,000 from 1953 to 1957, but from 1957 to mid-1958 the number dropped to 700.

Seasonal fluctuation in employment among the four industry groups is most evident in the lumber and wood products group. An appreciable drop in employment generally occurs in the spring and winter when heavy rains and floods usually hamper cutting and logging operations.

A general decrease in employment is evident for the industry as a whole. This drop may be attributed primarily to the decline in residential construction since 1955. From 1955 to 1956 the construction of new dwelling units dropped 21 per cent in Louisiana and 18 per cent in the United States. The following year housing starts were down another 2 per cent in Louisiana and 10 per cent for the nation as a whole.

Three other factors also contribute to the drop in employment during this period. They are: (1) increased mechanization, particularly in logging and sawmill operations, (2) expanded use of wood substitutes such as brick, concrete, asbestos, metals and plastics, and (3) increased durability of wood products through wood preserving treatments, particularly of utility poles, crossties, piling and framing timber. The lifespan of crossties, which formerly was 5 to 10 years, is now increased to 35 or 40 years by use of the wood preserving treatment.



Treating fence posts will increase their lifespan four to six times. (Urania, La.)

The Value of Forest Products

The stumpage value of sawtimber cut in 1957 was $16 million and the value of pulpwood $4.9 million, or a total stumpage value of almost $21 million accruing to owners of forest land.[13]

In 1957 the value of manufactured forest products was estimated to be about $735 million, or 17 per cent of the total value of the manufacturing output of Louisiana.[14] Furthermore, the total value of the finished products was 35 times the original stumpage value.

Severance taxes on lumber and pulpwood contributed a little more than $660,000 to state revenues while sales taxes on finished products contributed an estimated $5 million.

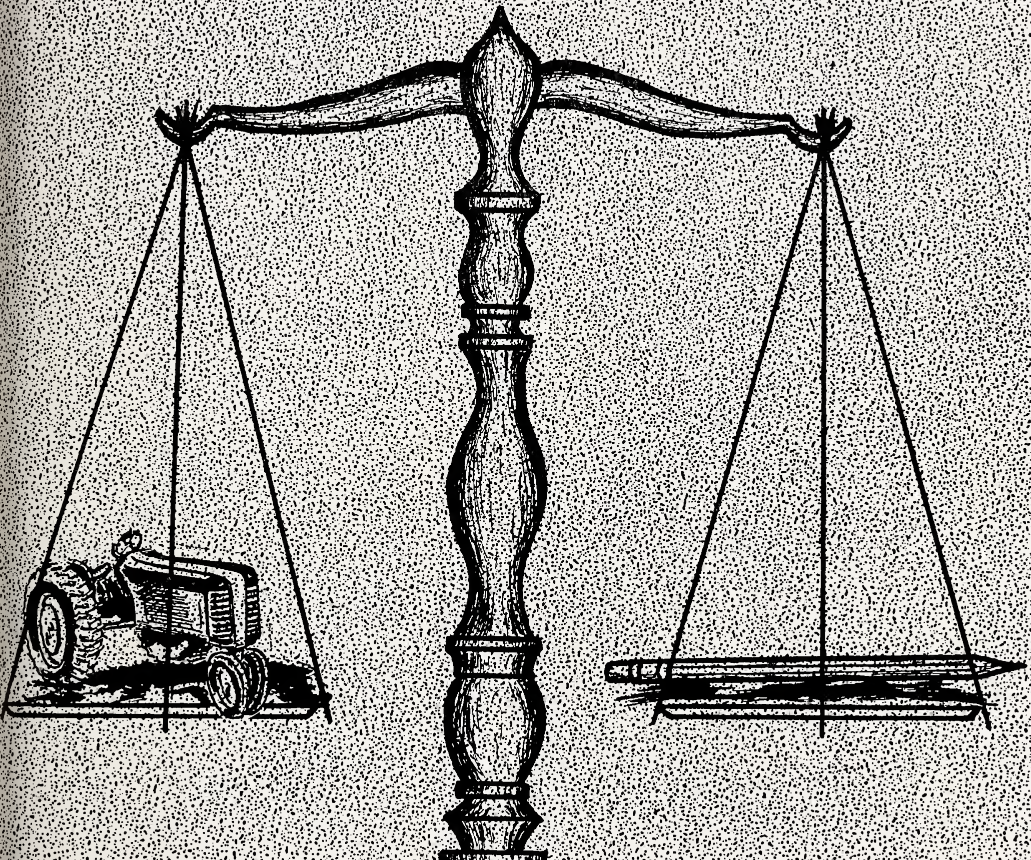
---

[13] Computation based on severance data provided by Louisiana Department of Revenue and the Louisiana State Forestry Commission.

[14] *Look at Louisiana Industry,* State Department of Commerce and Industry, 1958.

IMPROVING INCOME ON A MACON RIDGE COTTON FARM

a study in farm planning



RAY CORKERN, FRED H. WIEGMANN & AUSTIN JOHNSON

Bulletin No. 522

June 1959

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University
and Agricultural and
Mechanical College

TABLE OF CONTENTS

Page
SUMMARY AND CONCLUSIONS 3
INTRODUCTION 5
  Decision Making on the Farm 5
PURPOSE AND DESIGN OF STUDY 6
  Development of Data for the *Case* Farm 7
  General Application 7
BUDGETING PROCEDURE 8
  Data Needed and Source 8
    Prices 9
    Yields 9
    Computing Enterprise Costs and Returns 10
    Summarizing Receipts and Expenses for Farm Plans 11
    Selecting Alternative Enterprises 11
    Flexibility 11
  The Source of Increases in Net Income 12
FARM PLANNING AND ENTERPRISE BUDGETS 12
  Enterprise Budgets 13
THE ALTERNATIVE FARM PLANS 29
  Resumé of Alternative Plans 29
DETAILED COMPARISON OF ALTERNATIVE FARM PLANS 32
  Description 32
  Land Use 32
  Production Practices 35
    Fertilizer and Lime 35
    Seeding Rates 36
    Feed Requirements 36
  Crop and Livestock Yields 36
  Labor and Power Requirements 37
  Production and Disposition of the Products 39
  Expenses and Receipts 43
  Capital Requirements 46
  Summary of Expenses and Receipts 46
APPENDIX 48

SUMMARY AND CONCLUSIONS

The purpose of this analysis was to evaluate alternative systems of farming that might be adapted to a small cotton farm in North Louisiana and to illustrate the procedure for making such evaluations. The present and three alternative systems were budgeted for a "Case" farm. Net profits were then compared with profits under the present system.

It was assumed that the acreage in the farm would remain 93 acres, cotton acreage would remain 24.5 acres and maximum net farm income would be the farm goal.

When farm acreage is limited, farm income can be increased by (1) increasing yields, (2) changing enterprise combinations, (3) reducing costs of production, or (4) a combination of (1), (2) and (3). *These items are the key to increases in net farm income in the alternative systems.* Enterprise yields are expected to increase as a result of improved levels of practices and improved land capabilities. As soil fertility increases, yields are obtained for lower unit costs. The most profitable yield for a particular enterprise may not be the most profitable when considering the farm as a unit. This is true when resources are limited and can be used in other enterprises which may result in higher returns. Yields on the Case farm are relatively low under the present system. Under the alternatives these yields have been increased at additional cost. But for each enterprise the expected returns exceed expected costs.

Enterprise combinations have been changed in the alternatives. The crop enterprises have been organized around cotton. When combining enterprises, rotation systems, enterprise relationships, feed requirements, soil capabilities and resources available were considered. Under the given price relationships the combination of enterprises that yields the highest net return to the farm is the combination of cotton, corn, soybeans, broilers and winter grazing beef calves in plan "C". In this alternative all available resources are not fully used; family labor is an example. Usually all available resources cannot be fully utilized because a particular resource becomes limited. On this farm major limitations are total acres and cotton acres.

The cost of production has been reduced for the broiler enterprise under the alternative organizations. This was made possible by having the feed custom mixed and feeding the birds more often to prevent wastage. The change will result in a reduction of approximately $2,744 in cost. In the alternatives the total cost of production has increased for each enterprise except broilers. Increases in cost were necessary to obtain higher yields. However, cost per unit of production decreased. The yields obtained are thus consistent with the increase in cost.

The budgets indicate that the net farm income can be increased. To increase net farm income on the Case farm, adjustments are needed. These adjustments require only small increases in capital investments over the present organization (plan "A", $2,070.70; plan "B", $1,777.95; plan "C", $2,059.47) (Table 34). Increases in yields and the effect of a recombination of enterprises are reflected in the changes in the net farm income that can be expected from the alternative organizations. Returns to operator's family and labor are increased for each alternative over the present organization (plan "A", $3,824.07; plan "B", $4,937.92; plan "C", $6,188.23) (Table 36). These increases have been obtained for an increase in expenses in plans "A" and "B". Expenses in plan "C" have decreased. Total expenses increase for plans "A" and "B" by $11.39 and $1,103.32 respectively. Total expenses for plan "C" decrease by $678.27 (Table 35).

A budget analysis indicates that any of the three alternatives would be more profitable than the present system, while plan "C" is estimated to be most profitable.

Improving Income on a Macon Ridge Cotton Farm

A Study In Farm Planning

RAY CORKERN, FRED H. WIEGMANN[1] AND AUSTIN JOHNSON[2]

INTRODUCTION

The various changes taking place in agriculture make farm business management increasingly important. Many more farmers are beginning to realize this. One of the reasons for low farm income on many farms has been the lack of formal planning for the "whole farm." Farmers have been prone to request — and to be most receptive to — information in a "piecemeal" form. Too little attention has been given to how *all* the "pieces" (of the farm business) fit together.

Many educators have been conscious of this for a long time and have called attention to it. This has been particularly apparent to farm management economists, primarily because of their constant research on costs and returns and their concern with the economic principle of "alternative opportunity" (or "opportunity costs"). But the need for formal study of the "whole farm" approach to farm income is becoming more widely accepted by agricultural leaders in the field and by farmers themselves.

This study is concerned with the "whole farm" approach to farm planning and with the major tool used for planning. The tool is the "budget" and its use is called "budgeting."

Decision Making on the Farm

Farming is a complicated form of business enterprise. It is rapidly becoming more so. As in any other business, the decisions of the farm owner (manager) are fundamentally responsible for success or failure. As in any other business, a high net income is an important goal on the farm, and the manager's decisions come to focus, ultimately, on this goal.

To obtain maximum net income from resources used in farming, rational economic decisions must be made concerning production practices and farm organization. To make rational decisions some form of *organized planning* is required. "Budgeting" is an organized method of farm planning. It is a formal means of testing the relative profitability of alternative production practices or alternative organizations on the farm. The purpose of "budgeting" is to help the farm manager *select* the most profitable practices and organizations by permitting a comparison of costs and returns that can be expected with alternative practices and organizations. Farm budgets can be a major aid to the manager in making decisions and in planning for the future use of resources.

---

[1] Instructor and Associate Professor, respectively, Department of Agricultural Economics, Louisiana State University.

[2] Associate County Agent, Franklin Parish. The writers are indebted to the owner of the "Case" farm used in this study and to M. D. Woodin for constructive criticism of the manuscript.

Plans for one farm may not exactly fit another farm because each farm has different amounts and kinds of resources in the form of land, labor, capital and management. While farms may differ in this respect *the procedures used in planning the allocation of resources on farms, and the economic principles involved, are the same for all farms.*

Economic principles aid in farm planning by guiding decisions and showing the economic consequences, *in dollars and cents,* that will result from the use of given practices and organizations. *A budget is a tool for the practical application of economic principles.* Many farm operators have little or no formal knowledge of economic principles. Budgeting offers a practical means of putting principles of economics and good business management to work on the farm.

PURPOSE AND DESIGN OF STUDY

The budgeting approach to better farm incomes offers some advantages over the more commonly used enterprise approach. Consideration of the "whole farm" — the relationships between *all* potential enterprises and *all* available resources — is increasingly necessary as farms move away from single enterprises. However, budgeting and the "whole farm" approach have not been used as much in "the field" as will be necessary in the future. This tool is particularly important to farm planning programs such as Extension's Farm and Home Development program, the Farmers Home Administration, modern teaching in Vocational Agriculture and as a basis for farm financing.

This study was made in recognition of the need for information on the budgeting approach to farm planning.

The specific purposes of the study are:

(1) To show how farm budgets can be used in making decisions for the most profitable use of the farm's resources.

(2) To illustrate the method of preparing enterprise budgets.

(3) To show how enterprises are combined in alternative organizations.

(4) To compare costs and returns for several alternative farm organizations (using a Case farm as an example).

Development of Data for the "Case" Farm

The farm plans in this study are based on a 93-acre farm with 24.5 acres of cotton in Franklin Parish, Louisiana. The end result of proposed changes in the farming system is measured by means of a budget comparison of the present and alternative farming systems. The budgeting method provides a means of making estimates of returns from farming systems under given yields and production requirements, and given cost and price situations. The "alternative" systems selected are based on the assumption that the present size of the farm and cotton acreage allotment would remain the same, that proposed improved farm practices would be adopted, and that income maximization would be the immediate goal.[3]

Data used in the study (to estimate the various input-output relationships and resulting costs and returns from the present and alternative plans) were obtained from the farm operator, from various crop and livestock specialists, and from various publications of the Extension Service and the Agricultural Experiment Station. Data from sources other than the Case farm were adapted to the conditions prevailing on the farm.

To eliminate the effect of changes in the price level, and to make costs and returns comparable between plans, the same prices (received for farm products and paid for items used in production) were used in all plans. Prices were selected after considering the general price level and price trends in relation to average prices received and paid for farm products and production requirements over a recent five-year period, 1953-1957. While all the variables that may affect future prices cannot be precisely predicted, the prices used are assumed to be fairly representative for the near future.

General Application

While the farm plans shown are for a specific farm, the *general procedure* used in developing the plans is the same for any other farm.

All the enterprises budgeted for the Case farm may not be suitable for other farms. Other enterprises may be selected for alternative farm plans for other farms. Where similar enterprises are used in other farm plans, adjustments can be made in the input requirements, and the outputs expected, to fit the soils and other conditions of the individual farm. For example, inputs that may vary from those shown for the Case farm are seeding rates, fertilizer rates, labor and power requirements (see Appendix Tables B-9, B-11 and B-12, for general recommendations). Yields may also need adjustment, depending on the production potential of the specific farm being planned.

---

[3] Broilers were kept in all plans because of new investment and personal preferences of the operator.

The crop and livestock enterprise combinations for the alternative farm plans on the Case farm may differ from those that are possible for other farms. Once basic enterprise budgets have been developed for an area, they can be coordinated into farm plans to fit the conditions that exist on the specific farm being planned. In planning, several alternative farm plans should be developed and compared with the present organization for each farm.

The *steps followed* in developing farm plans for the Case farm can also be used on other farms. These steps were: (1) determination of resources that were available or potentially available, (2) selection of possible enterprises for the farm, (3) development of enterprise budgets for the present farm plan and other possible enterprises, (4) coordinating the enterprise budgets into whole farm plans, (5) comparing the present plan with the alternative farm plans and (6) selection of the farm plan that could be expected to yield the highest net farm income.

BUDGETING PROCEDURE

A farm budget can be classified in several ways, depending on how extensive and detailed it is or the production period which it considers. The classification is arbitrary. For planning purposes budgets can be classed as complete or partial. Complete budgets are extensive and detailed plans for the whole farm that usually extend over a number of years. If prepared for several years a budget may require alterations for any particular year to take advantage of changes in the market or other situations. Any permanent change in economic conditions may require a complete new budget. Such economic changes may include new technology or shifts in demand and supply conditions of a permanent nature. "Partial" budgets are used for planning a particular segment of the farm unit. Partial budgeting aids in making decisions relating to changes that would not necessarily involve changes in plans for the whole farm, and thus the development of a complete budget. A complete budget is actually a coordinated set of partial budgets. Many farmers do some kind of rough partial budgeting. Few go so far as complete budgeting.

Data Needed and Source

The reliability of any farm plan will depend upon the accuracy of the data used, the proper use of the data, and the good judgment of the estimator in predicting the results to be expected from the various resources used in a particular manner on a particular farm.

The basic data needed for farm planning are physical data. These include seed, feed, fertilizer, labor and power requirements for the various possible enterprises. Information is needed on practices to be followed and the levels of yields to be expected as the physical inputs and practices are varied. Price information is needed, together with data on soil types and topography and availability of financing. The characteristics of the individual farm operator and his family must also be taken into consideration.

The farm being planned is an important source of data, particularly such data as available labor, credit, soil types, etc. Additional data will have to come from other sources. These may include other farms in the same area, publications of the Agricultural Experiment Stations, Extension Service and other agencies and sources. When input-output data are used from sources other than from the farm planned, they should be adapted to the characteristics and potentialities prevailing on that farm.

Prices: An important decision when assembling data for farm budgeting is the selection of prices. While the individual farm operator has little or no influence upon prices received and paid he still must form "expectations" concerning future prices for budgeting purposes. All available sources of information must be considered in arriving at the prices to be used. The prices should reflect what can be expected to prevail in the local markets in which the operator usually buys and sells. The general price level and trend in prices must also be considered. This will require study of outlook reports issued by various state agencies and the U. S. Department of Agriculture.

Using a single year's price (such as last year's) is usually *not* a good practice in budgeting, particularly for making decisions that will be in effect over several years. An average of prices over a past period is a good "bench mark" for making such decisions, providing the general price level is considered and the past period is not one of abnormally low or high prices caused by conditions that are out of the ordinary and cannot be expected to last indefinitely (such as wars, droughts and other unforseen events that disrupt the normal market situation). Prices for inputs usually fluctuate less than prices for outputs.

Yields: Yields also are subject to fluctuation from year to year and are influenced by many factors. These include the level of management for a given farm, weather conditions, soil types, etc. The yields used in the budgets should be those that could be expected on the given farm when due account has been taken of the level of practices that will be used, trends in yields (generally upward), and the average effect of uncontrolled conditions (weather). Again, an average of past performances in the area, adjusted for expected practices and trend, will be most useful for a farm organization that will be in effect over several years. Single-year yields are too erratic to base long-run plans on.

Computing Enterprise Costs and Returns: Costs and returns must be computed for enterprises both separately and when they are combined in alternative farm plans. Partial budgeting is used when computing the costs and returns that can be expected from each enterprise and complete budgeting is used for each alternative organization. The purpose is to compare profits.

If different prices are used in computing costs and returns for the various alternatives, one alternative may appear more profitable than another. This profitability may be due to price differences only. Thus the *same prices* are used for each alternative enterprise (unless there is a difference in grade, quality, etc. between alternatives).

When *comparing two enterprises* (or levels of practices or farm plans) on a cost and return basis (in order to choose between them), fixed and variable costs that would be the *same* for either need not enter the computation since they cancel and would not affect the choice.[4] For example, where the choice is between an oat and a wheat enterprise and the cost for depreciation, interest, fuel, labor and repair for operating a combine are the same for each, these costs can be left out of the computation. This is an example in which some fixed and variable costs can be omitted when making a choice between two enterprises. However, fixed and variable costs that are *unique* to each of the enterprises must enter the computation.

Some fixed costs cannot be apportioned to any one enterprise with any degree of accuracy. Some forms of depreciation, rent and interest (overhead) are examples. The fixed costs that are not unique for any one enterprise should be charged to the whole farm. In Table 35 the fixed cost for depreciation in plan "C" is $909.06. Of this, $416.13 can be directly apportioned to the broiler enterprise in computing costs and returns for comparison purposes. (See Table 15.) But $492.93 cannot be apportioned to any one particular enterprise. It is charged to the *whole farm* and becomes part of the "overhead."

Computations will be easier if some tabular form is used. There is no strict rule governing arrangement of the tables, but some logical system should be used. The usual procedure is to arrange each enterprise into columnar form, indicating the input requirements, yields, costs and returns that can be expected.

---

[4] However, in this study costs that are similar *are shown,* in order to present as complete a picture as possible in illustrating the budgeting method.

Summarizing Receipts and Expenses for Farm Plans: After a combination of enterprises has been selected for each farming system being considered, a summary of the receipts and expenses for each should be compiled for comparison purposes. The receipts and expenses from the crop and livestock enterprises and other sources can be arranged in tabular form. From these summary forms, gross and net income, returns to operator's labor and management, the return on investment, and other measures of income can be computed. The net income figure for each system will indicate which alternative will return the highest net profit from the use of the farm's resources (Tables 31, 32, 35 and 36).

Selecting Alternative Enterprises: After the costs and returns for each possible alternative enterprise have been computed, the decisions must be made as to which enterprise or combination of enterprises will be the most profitable. This decision must consider each alternative in relation to the returns to the farm as a unit. When considered alone a particular enterprise may appear to be the most profitable. When it is considered in relation to the whole farm operation it may not yield maximum returns to the farm.

When selecting enterprises to combine for the farm, the relationships of the enterprises to each other must be given consideration. Enterprise relationships may be complementary, supplementary, or competitive.

Complementary relationships exist when an increase in the total output of one enterprise increases the total output from another enterprise (rotations, for example). When this relationship exists the complementary enterprise should be expanded until it becomes competitive for some resource. The amount of each enterprise to produce will then depend on the relative costs and returns.

Supplementary relationships exist when an enterprise does not compete with or add to the production of another but does make use of some resource that would otherwise not be used (small poultry flocks using family labor, for example).

Competitive relationships exist when enterprises compete for the same limited resource or resources (cotton and corn, for example). This is the usual relationship which exists between many enterprises, especially when capital or some other resource is limited. The combination of enterprises with this type relationship will depend upon the yields and prices of the products, the cost of producing each and the rate of substitution between the enterprises (i.e., possible combinations of enterprises).

Flexibility: Farm plans for any particular year or enterprise may require changes throughout the production period. These changes may be minor, such as using more or less of a resource because of changes in the relative prices of resources, or temporary changes in the rotation program. The profitability of changes of this nature can be determined by partial budgeting.

For enterprises which use resources that are good substitutes, a slight change in the relative prices of the resources may result in a different combination of inputs that will be the most profitable. To take advantage of this situation flexibility is needed in the budget. That is, the plan must provide opportunities for new decisions to be made as the plan unfolds. For example, the decision to hog-off corn or to sell it as grain can be postponed to see what develops in the market for both products.

The Source of Increases in Net Income

Two major factors influencing farm income are subject to the control of the manager. These are (1) the level of practices and (2) the farm organization (i.e., the combination of resources, enterprises, etc.). Farm income may be low because either or both need improving.

Budgeting ordinarily starts with the farm as it is—that is, with the current organization and level of practices. Costs and returns are determined for the farm under current practices and current organization. In setting up alternatives for comparison, the "budgeteer" can keep the current organization and show the results of improved practices or he may change some part of the organization (resources or enterprises, or both) or he can change both level of practices and organization. In most budgeting, "improvements" in practices show up in the enterprise budgets. "Improved" organization comes in combining alternative enterprises in different farming systems or plans. Usually these are done in this sequence (as in this study).

FARM PLANNING AND ENTERPRISE BUDGETS

In planning the farm each enterprise should be budgeted. This means that the physical inputs required, and the outputs that can be expected from them, are determined for each enterprise being considered. Basic data may be obtained from many sources, including the farm's records, experimental results or other farms in the area. If the enterprise being budgeted has never been considered previously, the data on inputs and outputs must come from sources other than the farm being planned. These data may need adapting to the specific farm because of the different conditions that usually exist on individual farms. New practices and techniques should be used if they are profitable. Partial budgeting can be used to determine this. (See Tables 10 and 16.)

Enterprise budgets can provide for adjustments as the production period progresses. The degree of adjustment that can be made will depend on the resources being used. Resources, once used, become a fixed cost, but if resource use can be postponed to some future period in the production process, an opportunity to make an adjustment is possible. For example, when fertilizer is applied in split applications any future applications remain variable. If a change in the price of the fertilizer (or the expected price of the output) occurs, more or less fertilizer may prove more profitable. Adjustments of this nature will result in higher net profits for an enterprise. Enterprise budgets may also need adjustments when co-ordinating individual budgets to obtain maximum returns to the farm as a unit.

To illustrate how enterprise budgets are developed the enterprises that are in the "present" farm organization and in plan "A" are discussed in this section. The present and alternative organizations include both crop and livestock enterprises. In the present organization there are cotton, corn, soybean, oat, wheat, pasture, beef and broiler enterprises. In plan "A" sheep are added and wheat is dropped. The physical requirements and the costs and returns for the crop enterprises are on a per-acre basis. For the livestock enterprises the physical requirements are shown on a per-head and total basis, and cost and returns are in dollar totals. Enterprise budgets for plans "B" and "C" are shown in Appendix A.

Enterprise Budgets

Cotton: Table 1 summarizes labor and power requirements per acre for cotton. The requirements for the present organization were obtained from the farm operator. Most of the requirements used in the "alternative" were adapted from various research publications. Each operation required (from land preparation to harvesting), the times the operations are performed, and the man and tractor hours required are shown in the table. In plan "A" two additional practices, liming and defoliation, are included. Liming will be done only once every eight years or when further applications are indicated as necessary by a soil test.

Estimated costs and returns per acre of cotton are shown in Table 2. The inputs are multiplied by their prices to compute costs, and outputs are multiplied by expected prices to compute estimated returns. The amounts of seed used under the present and alternative practices differ. Under present practices seed are not delinted and treated, thus requiring a larger poundage per acre. Another new practice for this farm under the alternative "A" is an increase in the amount of fertilizer used per acre as recommended by the Soil Testing Laboratory, Louisiana Experiment Station. With an increase in the fertilizer used and proper liming, it is estimated that the yield of lint will increase from .75 to 1.00 bale per acre and that the seed yield will increase from .29 to .47 ton per acre. Net returns are expected to increase from $47.90 to $86.94 per acre.

Corn: The labor and power requirements per acre of corn are shown in Table 3. Under alternative practices both man and tractor hours are increased. This is due to liming and an additional cultivation. Table 4 shows estimated costs and returns per acre of corn under present and alternative practices. Under present practices no fertilizer is used. Under alternative practices fertilizer will be applied as recommended by the Soil Testing Laboratory. Lime cost is prorated over an eight-year period. Under alternative practices it is estimated that the

TABLE 1.—Labor and Power Requirements per Acre for Cotton, Present and Alternative Practices

	Times Over		Man-hours		Tractor Hours	
Operation[1]	Present	Alternative	Present	Alternative[2]	Present	Alternative[2]
Cut stalks	1	1	.50	.50	.50	.50
Sow cover crop	1	1	.30	.30	.30	.30
Break land	1	1	2.00	2.00	2.00	2.00
Lime[3]	—	1	—	.50	—	.50
Bed row	1	1	.50	.50	.50	.50
Disc row	1	1	.50	.50	.50	.50
Fertilize	1	1	.50	.50	.50	.50
Rebed row	1	1	.50	.50	.50	.50
Harrow row	1	1	.50	.48	.50	.48
Plant	1	1	.50	.50	.50	.50
Cultivate	7	7	3.50	3.50	3.50	3.50
Poison	6	10	1.80	2.00	1.80	2.00
Hoe[4]	1	1	8.00	8.00	—	—
Defoliate[5]	—	1	—	.30	—	.30
Harvest:						
Mechanical[5]	1	1	3.00	2.71	2.00	1.94
Total			22.10	22.79	13.10	14.02

[1] These operations were performed on the Case farm. On other farms some of these operations may be omitted or additional operations may be required. For example, planting and pre-emerge is usually one operation. Adjustments can be made by using hour requirements given in Appendix Table B-9.

[2] Computed from Appendix Table B-9.

[3] Prorated over an eight-year period. Further applications will be made when indicated as necessary by a soil test. Where lime is not needed .50 man and tractor hours can be subtracted from total hours required.

[4] Hired.

[5] Custom hired.

TABLE 2.—Estimated Cost and Returns per Acre of Cotton, Present and Alternative Practices

Item	Unit	Amount		Price/ Unit	Total Cost & Returns	
		Present	Alternative		Present	Alternative
Seed						
Cotton	lbs.	40	18[1]	$ .076	$ 3.04	$ 1.37
Vetch[2]	lbs.	30	30	.173	2.79	2.79
Fertilizer[3]						
Sodium nitrate	cwt.	1.0	—	3.28	3.28	—
Ammonium nitrate	cwt.	—	.45	4.12	—	1.85
Superphosphate	cwt.	3.0	—	1.62	4.86	—
Muriate of potash	cwt.	1.0	—	2.65	2.65	—
3-12-12	cwt.	—	5.0	2.38	—	11.90
Lime[4]	ton	—	2.5	6.50	—	1.02
Pre-emerge	gal.	.13	.13	20.00	2.60	2.60
Poison[5]	lbs.	192.00	130.00	.10	19.20	13.00
Hoeing	hrs.	8.00	8.00	.60	4.80	4.80
Machine harvest[6]	cwt.	10.87	14.50	2.00	21.74	29.00
Ginning	bale	.75	1.00	13.11	9.83	13.11
Defoliate[6]	acre	—	—	2.75	—	2.75
Labor[7]	hrs.	11.10	11.78	.50	5.55	5.89
Power[7]	hrs.	11.10	11.78	.59	6.55	6.95
Total cost					$ 86.89	$ 97.03
Returns						
Cotton lint	bales	.75	1.00	160.00	$120.00	$160.00
Cotton seed	ton	.29	.47	50.99	14.79	23.97
Total returns					$134.79	$183.97
Net returns					$ 47.90	$ 86.94

[1] This is assuming that the seed have been treated, delinted and hill dropped.

[2] Federal cost-share, eight cents per pound for vetch seed under the Soil Conservation Program. Payments made on cover crops may vary slightly among areas and years. It is assumed that 30 pounds of nitrogen is provided by the cover crop.

[3] Fertilizer applied as recommended by the Soil Testing Laboratory, Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana. Under present practices sodium nitrate, superphosphate and muriate of potash used. In alternative practices on the *Case* farm, ammonium nitrate and 3-12-12 will be used. It is assumed that the cover crop will furnish 30 pounds of nitrogen per acre. For general fertilizer recommendations for other areas, see Appendix Table B-12.

[4] Lime prorated over an eight-year period. Federal cost-share under the Soil Conservation Program, $3.25 per ton. This payment may vary slightly among areas and years. Lime requirements for other farms should be determined by a soil test.

[5] Assumes poisoning performed 10 times at 13 pounds poison per application. This is an average application and may vary among individual farms. Several types and mixtures of poison may be used. A price of ten cents per pound is assumed.

[6] Custom hired.

[7] This assumes that all labor is hired. Family labor when available is considered a fixed cost and not a variable cost. This is considered in summary Table 35. Under present practices 11.00 man-hours and 2.00 power hours included under hoeing and machine harvest. In alternative practices 11.01 man-hours and 2.24 power hours included under hoeing, machine harvest and defoliation.

TABLE 3.—Labor and Power Requirements per Acre of Corn, Present and Alternative Practices[1]

	Times Over		Man-hours		Tractor Hours	
Operation	Present	Alternative	Present	Alternative	Present	Alternative
Disc land	2	2	1.00	1.00	1.00	1.00
Bed row	1	1	.50	.50	.50	.50
Disc row	1	1	.50	.50	.50	.50
Lime[2]	-	1	—	.60	—	.60
Fertilize	1	1	.60	.60	.60	.60
Rebed	1	1	.55	.50	.55	.50
Harrow	1	1	.50	.32	.50	.32
Plant	1	1	.50	.70	.50	.50
Cultivate	3	4	1.50	2.00	1.50	2.00
Harvest[3]	1	1	8.20	9.70	2.10	2.10
Total			13.85	16.42	7.75	8.62

[1] Labor and power requirements computed from Appendix Table B-9.

[2] Lime will be prorated over an eight-year period. Soil test will be used in determining when another application will be made.

[3] Based on hand harvesting. Hours required will vary depending on yield. If machine harvested with one-row equipment, 3.9-4.2 hours required; with two-row equipment, 2.8 hours required.

TABLE 4.—Estimated Cost and Returns per Acre of Corn, Present and Alternative Practices

		Amount			Total Cost & Returns	
Item	Unit	Present	Alternative	Price/ Unit	Present	Alternative
Seed	lbs.	9.7	8.0[1]	$ .207	$ 2.01	$ 1.66
Fertilizer[2]						
Ammonium nitrate	cwt.	—	2.12	4.12	—	8.73
3-12-12	cwt.	—	3.34	2.38	—	7.95
Lime[3]	ton	—	3.0	6.50	—	1.22
Labor[4]	hrs.	13.85	16.42	.50	6.93	8.21
Power[4]	hrs.	7.75	8.62	.59	4.57	5.09
Total cost					$13.51	$32.86
Returns						
Corn	bu.	20	50	1.20	$24.00	$60.00
Net return per acre					$10.49	$27.14

[1] *Reference Manual—Farm and Home Development,* Louisiana Extension Service, Baton Rouge, Louisiana, p. 14.

[2] As recommended by the Soil Testing Laboratory, Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana. See Appendix Table B-12 for recommendations for the other areas.

[3] Federal cost-share, $3.25 per ton under the Soil Conservation Program.

[4] See Appendix Tables B-1 and B-2 for distribution. All labor assumed hired.

yield will be increased by 30 bushels. With the increase in yield the net returns will be increased from $10.49 under present practices to $27.14 under the alternative practices.

Wheat: The labor and power requirements per acre are shown in Table 5. Table 6 shows the costs and returns per acre for wheat. This enterprise is not included in plans "A," "B," or "C." In the present organization wheat is being used for winter grazing and for grain. In the alternative organizations wheat is replaced with oats to provide the cereal grain to be used as feed in the livestock and broiler enterprises.

Oats: The oat enterprise budgets are presented in Tables 7 and 8. Table 7 shows labor and power requirements per acre of oats for the present and alternative practices. There is an increase of .20 man-hour and .10 tractor hour per acre required under the alternative practices from the addition of a liming operation. Small changes of this nature appear insignificant when the requirements are on a per-acre basis

TABLE 5.—Labor and Power Requirements per Acre of Wheat, Present Practices

Operation	Times Over	Man-hours	Tractor Hours
Disc land	2	1.0	1.0
Harrow	2	.9	.9
Seed	1	.3	.3
Fertilize	1	.3	.3
Combine[1]	1	1.3	.7
Haul	1	1.2	.7
Total		5.0	3.9

[1]Custom hired.

TABLE 6.—Estimated Cost and Returns per Acre of Wheat, Present Practices

Item	Unit	Amount	Price/Unit	Total Cost and Returns
Seed	bu.	3.5	$3.25	$11.38
Fertilizer				
Nitrogen	lbs.	16.0	.205	3.28
Labor[1]	hrs.	3.70	.50	1.85
Power[1]	hrs.	3.20	.59	1.89
Custom work	acre	—	—	7.50
Total cost	acre			$25.90
Returns				
Wheat	bu.	32	1.95	$62.40
Net returns				$36.50

[1]See Appendix Table B-9; 1.30 man-hours and .70 tractor hour custom hired on present organization.

TABLE 7.—Labor and Power Requirements per Acre of Oats, Present and Alternative Practices

	Times Over		Man-hours		Tractor Hours	
Operation	Present	Alternative	Present	Alternative[1]	Present	Alternative[1]
Plow land	2	2	1.00	1.00	1.00	1.00
Harrow	2	2	.90	.90	.90	.90
Seed	1	1	.30	.30	.30	.30
Fertilize	1	1	.30	.30	.30	.30
Lime	-	1	—	.30	—	.30
Combine[2]	1	1	1.30	1.20	.70	.60
Haul	1	1	1.20	1.20	.70	.60
Total			5.00	5.20	3.90	4.00

[1] Other farms may differ in the operations performed. Adjustment in requirements can be made by adding or subtracting certain operations.

[2] Custom hired.

TABLE 8.—Estimated Cost and Returns per Acre of Oats for Grain, Present and Alternative Practices

		Amount			Total Cost & Returns	
Item	Unit	Present	Alternative	Price/ Unit	Present	Alternative
Seed	bu.	3.5	3.0	$1.48	$ 5.18	$ 4.44
Fertilizer[1]						
Sodium nitrate	cwt.	3.0	—	3.28	9.84	—
Ammonium nitrate	cwt.	—	1.36	4.12	—	5.60
3-12-12	cwt.	—	5.00	2.38	—	11.90
Lime[1]	ton	—	2.5	6.50	—	1.02
Labor[2]	hrs.	3.70	4.00	.50	1.85	2.00
Power[2]	hrs.	3.20	3.40	.59	1.89	2.01
Custom work	acre	—	—	7.50	7.50	7.50
Total cost					$26.26	$34.47
Returns						
Oats[3]	bu.	50	60	.86	$43.00	$51.60
Net returns					$16.74	$17.13

[1] Recommended by the Soil Testing Laboratory, Louisiana Experiment Station, Baton Rouge, Louisiana. In present organization sodium nitrate used. In alternative, ammonium nitrate and 3-12-12 will be used. Lime prorated over an eight-year period. Federal cost-share, $3.25 per ton under Soil Conservation Program. For general fertilizer recommendations for other areas, see Appendix Table B-12.

[2] All labor assumed hired. Under present practices 1.30 man-hours and .70 power hour are custom hired. In alternative practices 1.20 man-hours and .60 power hour custom hired.

[3] For the *Case* farm, yields were 50 bushels per acre with slight grazing. It is assumed that yield may be increased to 60 bushels on the *Case* farm when grown for grain only and fertilizer is applied as recommended. For other farms yield adjustments must be made.

but they become a considerable amount when total acreages and requirements are considered.

Table 8 presents estimated costs and returns per acre of oats. Total costs per acre under alternative practices are increased from $26.26 for present practices to $34.47. The increased cost is due to an additional 12 pounds of nitrogen and 60 pounds of phosphate and potash and the application of 2.5 tons of lime. Oat combining is custom hired. The 10-bushel increase in grain yield per acre will apply only to those alternatives where oats are planted alone and are not heavily grazed by livestock.

Oats for Grazing and Grain: Table 7 shows labor and power requirements per acre. Total man-hours required is 5.20 and tractor hours is 4.00 (1.20 man-hours and .60 tractor hour are custom hired). The custom work includes combining the oats only.

For custom combining oats, there is a $7.50 charge per acre. Table 10 is a "partial" budget comparing the cost of custom combining 24 acres

TABLE 9.—Estimated Costs and Returns per Acre of Oats for Grazing and Grain

Item	Unit	Amount	Price/Unit	Total Cost & Returns
Seed				
Oats	bu.	3.5	$1.48	$ 5.18
Fertilizer[1]				
Ammonium nitrate	cwt.	2.00	4.12	8.24
3-12-12	cwt.	5.0	2.38	11.90
Lime[2]	ton	1.5	6.50	.61
Labor[3]	hrs.	4.30	.50	2.15
Power[3]	hrs.	3.70	.59	2.18
Custom work[4]	acre	1.0	—	7.50
Total cost				$37.76
Gross returns				
Oats	bu.	50.0	.86	$43.00
Net returns[5]	acre			$ 5.24

[1] Phosphate and potash applied as recommended for this farm by the Soil Testing Laboratory. Nitrogen has been increased by 36 pounds over recommendations because of heavy grazing.

[2] A cost of $4.88 prorated over an eight-year period. Federal cost-share under the Conservation Program, $3.25 per ton.

[3] Assumes all labor hired. Excludes 1.20 man-hours and .60 power hour which are included in the custom work. See Table 7 for requirements; .30 man and tractor hour has been added because of a split application of fertilizer.

[4] Custom work, $7.50 per acre for combining oats.

[5] This *does not include* the returns that are obtained from grazing. Returns from grazing will be in the form of livestock products and will be indicated in the returns from the sheep and beef enterprises.

TABLE 10—Comparison of Custom Combining 24 Acres of Oats to Purchasing Combine

Item	Unit	Amount	Price/Unit	Total Cost
Cost of new combine[1]	each			$1,515.00
Labor	hrs.	28.8	.50	14.40
Power	hrs.	14.4	.59	8.50
Depreciation[2]	yr.	—	—	101.00
Interest[3]	yr.	—	—	37.88
Repairs[4]	yr.	—	—	40.40
Total				$ 202.18
Cost to custom harvest 24 acres				$ 180.00
Difference for 24 acres				$ 22.18

[1] *Agricultural Prices,* U.S.D.A. Agricultural Marketing Service, Crop Reporting Board. The price is an average of 1953-1956.

[2] Assumed combine would last 15 years.

[3] Interest charged at 5 per cent of one half the original price of the new combine.

[4] Estimated life repair at 40 per cent of original price prorated over 15 years.

of oats to purchasing a combine. There is a difference of $22.18 between owning and custom hiring the combining. This difference suggests that the operator should not purchase a combine.[5] Partial budgets are developed in the same manner as enterprise budgets. In this partial budget the cost that would be incurred if the combine were owned was determined and compared with a cost of custom combining. Partial budgets serve to answer this kind of question. Estimated costs and returns per acre of oats for grain and grazing are summarized in Table 9.

Soybeans: The labor and power requirements are shown in Table 11. Under present practices the soybeans are turned under as a manure crop. In alternative plans the soybeans will be harvested for sale. Table 12 shows the costs and returns for soybeans for plan "A". Under plan "A" soybeans will follow the oat crop. This will require a late maturing variety.

Pasture: Table 13 summarizes the labor and power requirements per acre for establishment and maintenance of a white clover and Bermuda grass pasture. This pasture will be in alternative organization "A" only. Requirements for the establishment of the pasture include 3.83 man and tractor hours. The seeding operation is performed twice because of different planting dates for the clover and grass. To maintain the pasture 1.61 man and tractor hours are required. Table 14 shows the cost

---

[5] Actually, the difference in this case is so small that if this were the only basis for choice either would be valid. A difference of this amount ($22.18) could easily be an error in estimates.

TABLE 11.—Labor and Power Requirements per Acre of Soybeans, Present and Alternative Practices

Operation	Times Over		Man-hours		Tractor Hours	
	Present	Alternative	Present[1]	Alternative[2]	Present[1]	Alternative[2]
Break land	1	1	2.0	2.0	2.0	2.0
Bed rows	1	1	.5	.5	.5	.5
Disc rows	1	1	.5	.5	.5	.5
Plant	1	1	.5	.5	.5	.5
Cultivate	3	3	1.5	1.5	1.5	1.5
Turn under	1	—	.5	—	.5	—
Lime[3]	—	1	—	.6	—	.6
Fertilize	1	1	.6	.6	.6	.6
Combine[4]	—	1	—	1.2	—	.7
Haul	—	1	—	1.2	—	.6
Total			6.1	8.6	6.1	7.5

[1] In present organization soybeans turned under.

[2] In alternative organization soybeans will be harvested. Labor and power requirements computed from Appendix Table B-9.

[3] Prorated over an eight-year period. Further applications will be made when indicated as necessary by a soil test.

[4] Custom hired.

TABLE 12.—Estimated Cost and Returns per Acre for Soybeans in Alternative "A"[1]

Item	Unit	Amount	Price/Unit	Total Cost and Returns
Seed[2]	lbs.	45	$ .083	$ 3.74
Fertilizer[3]				
3-12-12	cwt.	5	2.38	11.90
Labor[4]	hrs.	7.4	.50	3.70
Power[4]	hrs.	6.8	.59	4.01
Custom combining	acre	—	—	7.50
Total cost				$30.85
Returns				
Soybeans	bu.	25	1.95	$48.75
Net returns				$17.90

[1] Under alternative "A" soybeans will follow the oat crop.

[2] Late maturing variety used.

[3] As recommended by the Soil Testing Laboratory, Louisiana Agricultural Experiment Station. Lime will not be used for the soybeans because the oat crop was limed. For general recommendations for other areas, see Appendix Table B-12.

[4] See Appendix Table B-9 for labor and power requirements. Assumes all labor hired.

TABLE 13.—Labor and Power Requirements per Acre for Establishment and Maintenance, White Clover and Bermuda Grass Pasture[1]

Operation:	Times Over	Man-hours	Tractor Hours
	Establishment		
Discing	2	1.00	1.00
Harrowing	1	.32	.32
Fertilizing	1	.45	.45
Liming[2]	1	.45	.45
Seeding	2	1.12	1.12
Cultipacking	1	.49	.49
Total		3.83	3.83
	Maintenance		
Mowing	2	1.16	1.16
Fertilizing	1	.45	.45
		1.61	1.61
Total		5.44	5.44

[1] Computed from Appendix Table B-9.

[2] Prorated over an eight-year period. Further application will be made when indicated as necessary by a soil test.

TABLE 14.—Estimated Cost per Acre for Establishing and Maintaining White Clover and Bermuda Grass Pasture

Item	Unit	Amount	Price/Unit	Total Cost
Seed				
White clover[1]	lbs.	3.0	$ .85	$ .85
Bermuda[1]	lbs.	5.0	.52	.87
Fertilizer[2]				
Ammonium nitrate	cwt.	1.36	4.12	5.60
3-12-12	cwt.	5.00	2.38	11.90
Lime[3]	ton	1.5	6.50	.61
Labor[4]	hrs.	2.89	.50	1.45
Power	hrs.	2.89	.59	1.71
Total				$22.99

[1] Prorated over a three-year period.

[2] Phosphate, potash and lime applied as recommended by Soil Testing Laboratory, Agricultural Experiment Station, Baton Rouge, Louisiana. Nitrogen increased by 45 pounds over recommendations because of heavy grazing. For general recommendations for other areas, see Appendix Table B-12.

[3] Prorated over an eight-year period. Federal cost-share under the Soil Conservation Program, $3.25 per ton.

[4] Hours required to establish prorated over a three-year period. See Table 13. All labor assumed hired.

TABLE 15.—Estimated Cost and Returns for Broilers, Present and Alternative Practices

		Amount			Total Cost & Returns	
Item	Unit	Present	Alternative	Price/ Unit	Present	Alternative
Chicks	no.	25,000	25,000	$ 1.22	$ 3,050.00	$ 3,050.00
Feed[1]	cwt.	2,053	—	5.60	11,496.80	—
	cwt.	—	2,026	4.32	—	8,752.32
Electricity	——	—	—	—	60.00	60.00
Fuel	gal.	1,184	1,184	.145	171.68	171.68
Litter	ton	4	4	5.50	22.00	22.00
Medicine	each	—	—	.003	75.00	75.00
Insurance	——	—	—	—	20.00	20.00
Hauling	——	—	—	10.00	50.00	50.00
Pickup broilers	——	—	—	20.00	100.00	100.00
Depreciation[2]	yr.	—	—	—	416.13	416.13
Labor[3]	hrs.	752	1,038	.50	376.00	519.00
Tractor	hrs.	2	4	.59	1.18	2.36
Total					$15,838.79	$13,238.49
Returns						
Broilers[4]	lbs.	68,439	72,780	.19	$13,003.41	$13,828.20
Net returns[5]					$--2,835.38	$ 589.71

[1] This would be 3 pounds of feed per pound of gain under present practices. With alternative practices, 2.785 pounds of feed per pound of gain. Based on data of Roy, Ewell P. *Cost and Returns in Producing Louisiana Broilers, 1951-54,* D.A.E. Circular No. 170, Louisiana Exp. Sta., p. 23; see also Appendix Table B-3.

[2] Includes depreciation for broiler house, waterers and feeders.

[3] See Appendix Table B-1 for monthly distribution. This assumes all labor hired. (Actually family labor.)

[4] Birds sold at 3 pounds. The price is a projected estimate. The 1953-1957 average price per pound was 23.38 cents. It is estimated that the price will decrease because of the increase in production in Louisiana and throughout the South.

[5] 1,437 chicks were lost owing to circumstances (a hurricane) that will not exist every year. For comparison the returns and costs for these are included under present practices.

per acre for establishing and maintaining this pasture. The returns are not presented in the table since they will be in the form of livestock products. Seed cost is prorated over a three-year period, which is the expected life of a pasture with this particular combination. Fertilizer and lime will be applied as recommended by the Soil Testing Laboratory, Agricultural Experiment Station.

Broilers: The broiler enterprise is in each alternative organization.[6] Table 15 shows estimated cost and returns from broilers under present and alternative practices. Feed cost represents the major cost item in a broiler enterprise. Any practice that will reduce this cost should be adopted. Under present practices a ready mixed feed is used. Under plan "A" feed will be custom mixed. Table 16 is a partial budget comparing cost of feed when corn is custom mixed with a pre-mixed supplement to the cost of a complete feed purchased. The total cost per hundred pounds of feed when custom mixed is $4.32 as compared to $5.60 per hundred pounds for the ready mixed feed. The difference of $1.28 per hundred pounds will result in a reduction in cost under the alternative practices.

---

[6] Broilers kept in all three alternatives because of personal preference of the operator.

Several cost items will be the same under present and alternative practices. Labor requirements are increased from 752 hours with present practices to 1,038 hours with the alternative practices, because of more frequent feeding to prevent wastage of feed. Depreciation is charged to this enterprise because it can be directly charged to the broilers. This would not be the case if the broiler house and equipment were used for some other purpose during the year.

There is a wide variation in the net returns under the present and alternative practices. During 1957 ("present practices") 1,437 broilers were lost because of a hurricane. This is a most unusual event that will not occur every year. For a valid comparison of net returns from the present practices and alternative practices, the cost and returns from these birds must be included under the present practices as though they had not been lost. The added cost for the chicks lost would have been $270.05 and the added returns would have been $819.09. Net returns (for comparison with the alternative practices) would have been $-2286.34. Under alternative "A" net returns are estimated at $589.71.

Sheep: The sheep enterprise consists of 70 ewes and 2 rams. Table 17 shows the feed, labor, and land and power requirements for the flock.

TABLE 16.—Comparison of Feed Cost When Corn is Custom Mixed with a Pre-Mixed Supplement, to Purchasing a Complete Feed[1]

Item	Unit	Amount Required	Price/Unit	Total Cost
Pre-mixed supplement	cwt.	.337	7.80	$2.63
Corn	cwt.	.663	2.48	1.42
Grind corn	cwt.	—	.25	.17
Mix feed	cwt.	—	.10	.10
Total				$4.32
Complete feed	cwt.	—		$5.60
Difference	cwt.			$1.28

[1] Both feeds contain 18 per cent protein.

TABLE 17.—Feed, Labor, Land and Power Requirements for a 70-Ewe, 2-Ram Flock

Item	Unit	Amount	Total Required
Breeding flock[1]			
Oats	lbs. per hd.	.31	669.6
Corn	lbs. per hd.	.31	669.6
Hay	lbs. per hd.	2.00	4,320.0
Lambs			
Oats[2]	lbs. per hd.	.14	2,100.0
Corn[2]	lbs. per hd.	.14	2,100.0
Hay[3]	lbs. per hd.	.75	1,764.0
CSM[3]	lbs. per hd.	.15	352.8
Labor			
White clover			
Bermuda[4]	hrs. per acre	1.73	41.5
Sheep[5]	hrs. per hd.	2.62	188.6
Land			
Pasture[6]	acres per hd.	.33	24.0
Oats[6]	acres per hd.	.33	24.0
Corn	acre	—	.3
Power requirements			
Pasture[7]	hrs. per acre	1.73	41.5

[1] DeRouen, T. M., *The Sheep Enterprise in Louisiana,* Animal Industry Circular 50, revised 1956, Louisiana Agricultural Experiment Station. Oats, corn and hay fed one month prior to lambing. This would be the latter part of December and the first part of January.

[2] Assumes 25 pounds per lamb or approximately .14 pound per head for 181 days. Recommended by Charles L. Hill, sheep specialist, Louisiana Extension Service, Baton Rouge, Louisiana.

[3] *Illinois Farm and Home Development Reference Book,* University of Illinois, College of Agriculture, Extension Service in Agriculture and Home Economics, January 1955, p. 39. The hay requirements have been reduced by .25 pound because of good winter pasture. Protein supplement has been reduced .5 pound. Lambs fed for the month of February only.

[4] See Table 13; 1.73 man-hours per acre is the pro-rata share for sheep enterprise; 1.16 man-hours per acre will be charged to the cattle enterprise.

[5] Parvin, D. W. *An Economic Appraisal of Sheep Production in the Northeast Prairie of Mississippi,* Bul. 495, December 1952, p. 15. Mississippi Agricultural Experiment Station, State College, Mississippi. See also Appendix Table B-1 for monthly distribution of labor.

[6] Assumes that pasture would carry 1.5 animal units per acre. An animal unit is 1 mature cow or 2 yearling calves, 1½ weaned calves, 10 weaned lambs, or 5 mature sheep. One acre will carry .9 animal unit or 3 ewes and lambs and .6 animal unit of cattle.

[7] See Table 13; 1.73 tractor hours per acre pro-rata share for sheep enterprise; 1.16 tractor hours per acre will be charged to the cattle enterprise.

TABLE 18.—Estimated Cost and Returns from a Sheep Enterprise (70-Ewe Flock)

Item	Unit	Amount	Price/Unit	Total Cost and Returns
Pasture[1]	acre	24	$13.79	$ 330.96
Feed				
Corn	bu.	49.40	1.20	59.28
Oats	bu.	86.40	.86	74.30
Hay	ton	3.04	26.40	80.26
CSM	cwt.	3.53	4.00	14.12
Worming[2]	lbs.	17.40	.60	10.44
Spraying[3]	lbs.	12.50	.33	4.13
Marketing[4]	each	4%	—	53.21
Salt[5]	cwt.	9.08	1.49	13.53
Steamed bone meal[6]	cwt.	7.20	3.50	25.20
Oystershell flour[6]	cwt.	7.20	1.25	9.00
Shearing[7]	each	72.00	.50	36.00
Building & equipment[8]	—	—	—	90.00
Labor[9]	hrs.	188.6	.50	94.30
Total cost				$ 894.73
Gross returns				
Lambs[10]	cwt.	62.05	17.05	$1,057.95
Cull sheep[11]	cwt.	88.40	7.32	6.49
Wool[12]	lb.	430.00	.49	210.70
Total returns				$1,330.14
Net returns[13]				$ 522.47

---

[1] Pro-rata share for the sheep enterprise is $13.79 per acre. The pro-rata share for the beef enterprise is $9.20 per acre. See Table 14 for costs.

[2] One ounce per mature animal, 15 ounces per lamb. Wormed three times, DeRouen, T. M. *The Sheep Enterprise in Louisiana,* Animal Industry Circular 50, revised 1956, Agricultural Experiment Station, Baton Rouge, Louisiana, p. 29.

[3] Four pounds of wettable DDT per 100 gallons of water. *Ibid,* p. 31.

[4] Four per cent of gross sales.

[5] Morrison in *Feeds and Feeding,* 21st Edition, p. 861, recommends .25 to .50 ounce per head per day.

[6] *Reference Manual-Farm and Home Development,* Louisiana Extension Service, p. 74.

[7] Custom hired.

[8] Total cost of $450.00 required. Prorated over a 5-year period.

[9] See Table 13 and 14; pro-rata share of 41.5 man-hours and tractor hours charged under pasture for the sheep enterprise.

[10] Seventy-three lambs sold at 85 lbs. each, 7 saved for replacement, death loss 4.

[11] Ten per cent of ewes will be culled each year. Rams will be culled every two years to prevent inbreeding.

[12] Seventy-two head at six pounds per head. Lambs will not be sheared.

[13] Net returns increased by $87.06 because of wool incentive program. Support price for shorn wool has been 62 cents per pound, 1955-1957. For unshorn wool on lambs payments vary depending on the amount sold during the marketing season. For 1956-57 this has amounted to 71 cents per 100 pounds product sold.

Feeding will be on a limited scale because good pastures are provided. The breeding flock will be fed for one month prior to lambing and the lambs will be fed oats and corn for 181 days. Hay and cottonseed meal will be fed during February. The labor and power required for the pasture is the pro-rata share for the sheep enterpise. Land requirements for the pasture and oats are based on a capacity of 1.5 animal units per

TABLE 19.—Estimated Cost and Returns from Beef Cattle, Present and Alternative Organization "A"[1]

Item	Unit	Total Amount Present	Total Amount Plan A	Price/ Unit	Total Cost & Returns Present	Total Cost & Returns Plan A
Feed						
Corn	bu.	4.8[2]	32.0[3]	$ 1.20	$ 5.76	$ 38.40
Oats	bu.	8.4[2]	96.0[3]	.86	7.22	82.56
CSM	cwt.	—	2.4[3]	4.00	—	9.67
Veterinary[4]	hd.	—	—	1.03	—	18.54
Hauling	hd.	6.0	8.0	1.00	6.00	8.00
Salt[5]	cwt.	2.2	1.9	1.49	3.29	2.83
Steamed bone meal[5]	cwt.	—	1.9	3.50	—	6.65
Oystershell flour[5]	cwt.	—	1.9	1.25	—	2.38
Marketing[6]	—	—	—	4%	17.06	24.33
Labor[7]	hrs.	123.0	53.7	.50	61.50	26.85
Pasture	acre	20.5	24.0	—	11.23[8]	220.80[9]
Total cost					$112.06	$441.01
Returns						
Calves[10]	cwt.	27.0	38.5	15.80	426.60	608.30
Net returns					$314.54	$167.29[11]

[1] In the present organization there are 11 cows, 1 bull and 7 calves. In alternative "A" there will be 9 cows, 8 calves, 1 bull and 1 yearling.

[2] Feed for calves only.

[3] For calves only; 4 bu. corn, 12 bu. oats, and 30 lbs. cottonseed meal per head.

[4] Medicine and vaccination included. Based on survey made in 1956.

[5] Twenty pounds of salt, steamed bone meal and oystershell flour per cow and calf, 20 pounds for bull, 10 pounds for yearling.

[6] Four per cent of gross sales.

[7] Labor for cattle only. Assumes all labor hired.

[8] Includes 10.3 man and tractor hours for maintenance of pasture only.

[9] Pro-rata cost per acre, $9.20 per acre charged to cattle, $13.79 charged to sheep enterprise. See Tables 14 and 18.

[10] For present organization, 6 sold at 450 pounds each. In alternative organization, 7 sold at 550 pounds each.

[11] Does not include returns from sheep and is thus not directly comparable with the $314.54 under present practices. For a valid comparison of total and net returns, include returns from sheep (Table 18), since this alternative includes sheep *in combination* with beef cattle. See Table 20 and discussion on Page 28.

acre.[7] Sheep will provide .9 animal unit, or three ewes and lambs per acre. The remaining .6 animal unit will be for the cattle enterprise.

Table 18 shows the estimated costs and returns from the sheep enterprise. The pasture charge of $13.79 is the pro-rata share for sheep of a total pasture cost of $22.99 (Table 14). Building and equipment charge is $90.00 per year. Total building and equipment cost is $450.00. This is prorated over a five-year period. Power cost is included under the pasture cost, which was prorated to the sheep and cattle enterprises. The pasture cost includes 41.5 hours pro-rata share for the sheep enterprise. Gross returns include returns from the sale of 73 lambs, 7 cull sheep and 430 pounds of wool. Net returns, for comparison purposes, are $522.47. (See also footnote 11, Page 27.)

Beef: The estimated cost and returns from the beef enterprise for the present practices and practices under alternative organization "A" are shown in Table 19. There is an increase in feed cost under the alternative practices. This is necessary to have the calves weighing 550 pounds when marketed. With the present practices the calves are sold at 450 pounds each. Pasture cost with present practices is $.55 per acre. This cost includes 10.3 man and tractor hours for the maintenance of a 20.5-acre pasture. The pasture cost with alternative practices is $9.20 per acre for 24 acres (Table 20). This is the pro-rata share for beef of a total pasture cost of $22.99.

Net returns (to beef alone, Table 19) with present practices exceed the net returns with alternative practices. However, this figure *does not include* returns to the sheep enterprise, *which is a part* of this alternative. For a valid comparison of present and alternative returns it is necessary to include the returns to the sheep enterprise. Table 20 compares the costs and returns per acre from the pasture from the combination beef-sheep enterprise under alternative organization "A". It is necessary to put the comparison on a per-acre basis before a decision as to the profitability of the beef and sheep enterprises is made. This is possible because the acreage in pasture is used by both kinds of livestock. The costs and net returns are prorated to these two enterprises under the present and alternative practices. Without the addition of the sheep enterprise in alternative organization "A" the net return per acre is $11.49. With returns from the sheep enterprise added the net return per acre is $28.74.

Additional enterprise budgets for enterprises under alternatives "B" and "C" are presented in Appendix A.

---

[7] An animal unit is 1 mature cow or 2 yearling calves, 1½ weaned calves, 10 weaned lambs, or 5 mature sheep.

TABLE 20.—Comparison of Cost and Returns per Acre from Pasture in Alternative "A" When Sheep Enterprise Is Added[1]

Item	Present	Alternative
Pasture cost:		
Beef	$ .55	$ 9.20
Sheep	—	13.79
Net returns:	$ .55	$22.99
Beef	$15.34	$11.49
Sheep	—	17.25
	$15.28[2]	$28.74[3]

[1] See Tables 18 and 19 for cost and returns for beef and sheep enterprise.

[2] $314.54 (Table 19) divided by 20.5 acres

[3] $167.29 (Table 19) + $522.47 (Table 18) divided by 24 acres.

THE ALTERNATIVE FARM PLANS

The procedure, once the present and alternative enterprises are budgeted, is to coordinate these enterprise budgets into farm plans for the organization and operation of the farm being planned. An analysis and comparison of the present and alternative farm plans will indicate which should be selected for the farm. The farm plan selected may require adjustments in current production practices, capital requirements and enterprise combinations. If an adjustment can be made and will result in higher returns to the farm as a unit, it should be adopted. Budgeting helps to determine what adjustments may be made and whether they will be profitable if adopted.

Farm plans are based on averages and expectations. Thus, actual results may not turn out precisely as planned. This frequently occurs. Although this is true, farm plans aid in making rational economic decisions relating to the organization and operation of the farm.

Resume of Changes in Organization and Practices Under the Alternative Plans

It is assumed that the cotton acreage in each alternative will remain unchanged and the size of the farm in acres will remain the same. Therefore, alternative crop and livestock enterprises are organized around the cotton enterprise. Reorganization is expected to result in a higher net farm income. A summary of land use and livestock organization for the various alternatives is given in Table 21. The "changes" discussed are in relation to the present system on the farm.

Plan "A": The major difference between the present organization and plan "A" is the addition of a sheep enterprise. With this addition the pasture acreage can be more fully utilized. Oats will be used for winter grazing and grain. Following the oat crop a late maturing variety of soybeans will be planted for beans. Corn acreage for plan "A" will be reduced by 7.5 acres from the present. This does not provide all the corn that is needed for the broiler enterprise but is sufficient for the feed requirements of the sheep and beef cattle. Any corn in excess of feed requirements for the sheep and beef cattle will be used for broiler feed. Changes in livestock enterprise would include the sale of two beef

TABLE 21.—Land Use and Livestock Numbers for Present and Alternative Organizations

	Present		A		B		C	
Land Use	Field No.	Acres	Field No.	Acres	Field No.	Acres	Field No.	Acres
Cotton	2	7.0	1	24.5	1	24.5	1	24.5
	4	17.5	—	—	—	—	—	—
Corn	3	14.5	3	12.0	6	16.3	2	24.5
	5	5.0	—	—	—	—	—	—
Soybeans[1]	1	10.0	—	24.0	—	—	3	15.0
	7	4.0	—	—	—	—	—	—
Oats[2]	6	10.0	2	24.0	3	6.4	—	—
Wheat	6	10.0	—	—	—	—	—	—
Corn & beans	—	—	—	—	2	31.3	—	—
Pasture	9	20.5	4	24.0	4	6.0	4	20.5
Homestead	8	3.5	5	3.5	5	3.5	5	3.5
Woodland	10	5.0	6	5.0	7	5.0	6	5.0
			Number					
Livestock								
Pony	1		—		—		—	
Horse	1		—		—		—	
Bulls	1		1		—		—	
Beef cattle	11		9		—		—	
Beef calves	7		8		—		34	
Broilers	25,000		25,000		25,000		25,000	
Ewes	—		70		—		—	
Lambs	—		84		—		—	
Rams	—		2		—		—	
Sows	—		—		12		—	
Boars	—		—		1		—	
Market hogs	—		—		168		—	

[1] Four acres in field 7 double cropped (previous crop oats). Total acreage turned under in August.

[2] Oats harvested May 1957, wheat planted September 1957 for present organization. Field number 2 in plan "A" will be double cropped with soybeans.

cows, one horse and one pony. Seventy ewes and two rams would be purchased. The changes in the livestock enterprises will require careful pasture management. Family labor will increase 500 hours (Appendix Table B-1) and labor hired will increase 108 hours. The productivity of the soil will be improved under plan "A" by additional use of fertilizer and lime, and by a rotation of row crops with a small grain crop and the use of a cover crop following the cotton crop. Net farm income expected from plan "A" is $4,000.46 (Table 36), or an increase of $3,824.07 over the present organization. Plan "A" will require an additional capital investment of $2,070.70 (Table 34) and an increase in annual expenses of $11.39 (Table 35).

Plan "B": Changes in crops grown in plan "B" will include the addition of 31.3 acres of corn and soybeans and reductions of 3.2 acres of corn, 3.6 acres of oats and 14.5 acres of pasture. The livestock program will consist of hogs and broilers. Two litters of pigs will be farrowed each year. The corn and soybeans will be hogged-off, thus reducing the labor requirements on this enterprise. The addition of a hog enterprise will require the purchase of a protein supplement and a pig starter. The oat enterprise is increased to provide a new pasture for the fall litter and oat requirements for feed. The rotation of the hogs between the oats and pasture is expected to reduce the risk from diseases. Enough corn is produced to meet the feed requirements of the hogs but corn will be purchased for the broiler enterprise. The cotton crop will be followed by a cover crop. Utilization of family labor will be increased by 727 hours (Appendix Table B-1). One disadvantage of this plan is the requirement of 171 hours of seasonal labor, which may be difficult to hire

Net farm income from plan "B" is expected to be $5,114.31 (Table 36), or an increase over the present organization of $4,937.92. An increase of $1,777.95 in capital requirements (Table 34) and a $1,103.32 increase in expenses (Table 35) will be required for this plan.

Plan "C": Changes in both crops and livestock will be made under plan "C". Corn acreage is increased by five acres over the present acreage. Fifteen acres of soybeans will be planted for harvesting. Pasture acreage remains the same but will be improved to provide winter grazing. An oat and rye grass combination is expected to provide sufficient grazing for the beef cattle. Roughage from the corn will be used by the beef cattle during the two-month feeding period, mid-October through mid-December. Livestock will consist of 34 head of 450-pound calves. The calves will be winter-grazed from December until May. Pasture management will include three applications of nitrogen. The use of nitrogen will be greater than recommended by the Soil Testing Laboratory because of heavy grazing. Soybeans have been added to the rotation of corn and cotton in the place of a small grain crop. Small grain is not needed as a feed, and soybeans will improve the soil more than a small grain crop. The cotton is also followed by a cover crop.

Added capital investment for plan "C" is $2,059.47 (Table 34). Total expenses are decreased by $678.27 (Table 35). Net farm income in comparison with the present organization is $6,364.62, or an increase of $6,188.23 (Table 36). This increase results from a change in the class of livestock and the expected returns from the soybeans.

DETAILED COMPARISON OF ALTERNATIVE FARM PLANS

Three alternative organizations have been budgeted for comparison with the present organization. In this section the component parts of the farm plans will be compared. These parts are: land use, production practices, yields, labor and power requirements, production and disposition of the products, expenses, receipts and capital requirements.

Description

In Figure 1 are farm maps showing the field layouts, drainage system, buildings and fences for present and alternative organizations. The soil on the farm is a silty clay loam. The farm is level to slightly rolling except in field 9 (present organization), which has a constant two or three degree slope. When row crops are grown in this field the rows will be parallel to the slope. Some drainage is required for the other fields. The present drainage system is adequate. There is no erosion on the farm. The farm buildings (in addition to a house) for each plan will consist of a broiler house and tool shed already on the farm. The tool shed provides space for farm implements, storage space for crops and an overhanging shed for livestock. The broiler house provides adequate space for 5,000 birds. Permanent fencing will remain the same for the present organization and alternative "C". Under these two organizations 25.5 acres are fenced. The farm will be completely fenced under plan "A". For plan "B", 53.6 acres will be fenced but 31.3 acres of this will be a temporary fence.

Land Use

Of the 93 acres in the farm there are 84.5 acres in cultivation, 3.5 in the farmstead and 5 acres in woodland. Total land requirements remain the same in all alternatives. Table 21 shows the use and acreage for each field. Livestock numbers for each organization are also shown. Cotton acreage remains the same in each organization. Acres in other enterprises and the number of livestock, except broilers, will vary.

FIGURE 1.—Farm Maps for Present and Alternative Organizations

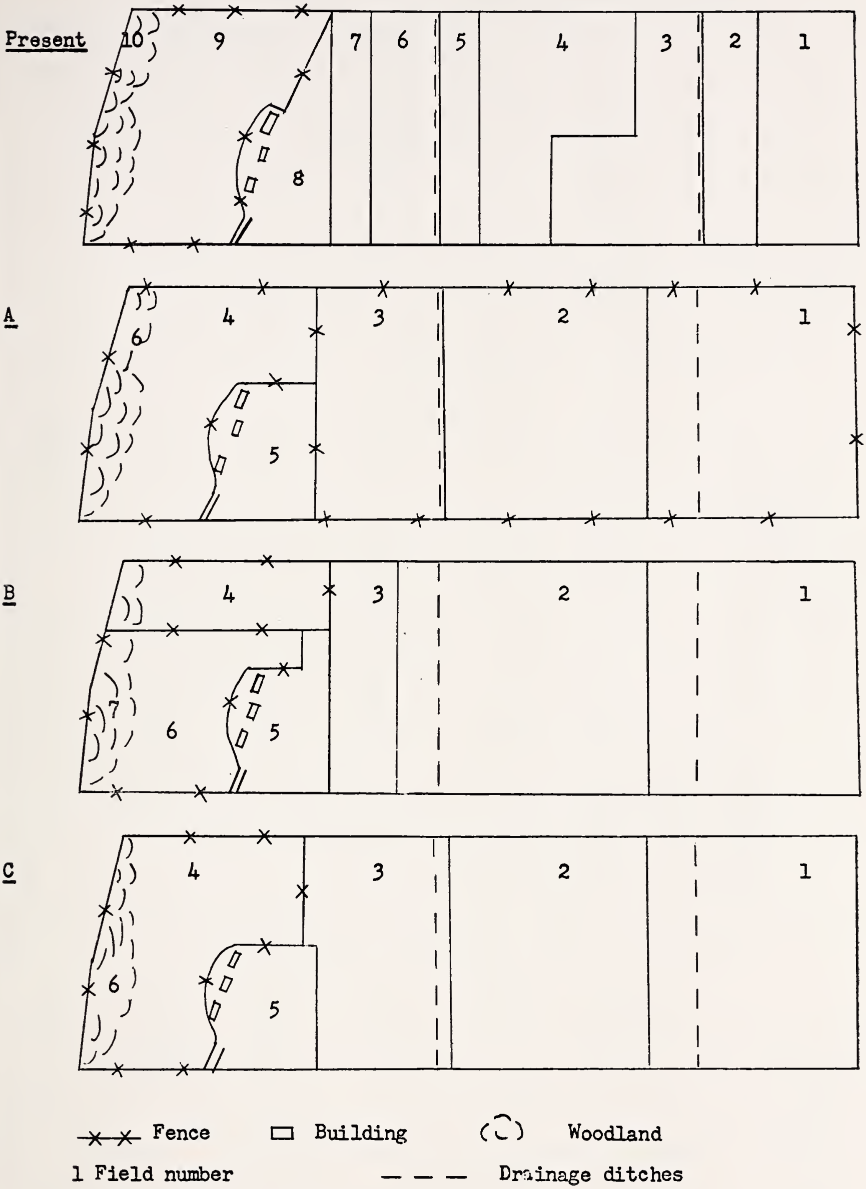


TABLE 22.—Estimated Total Seed and Fertilizer Requirements for Present and Alternative Organizations

			Fertilizer			
Crop	Acres	Seed (Pounds)	N (cwt.)	P_2O_5 (cwt.)	K_2O (cwt.)	Lime (ton)
			Present Organization			
Cotton	24.5	980.0	3.92	14.70	15.19	—
Corn	19.5	189.2	—	—	—	—
Oats	10.0	976.0	4.80	—	—	—
Wheat	10.0	2,100.0	1.60	—	—	—
Soybeans	14.0	420.0	—	.60	.62	—
Vetch	24.5	735.0	—	—	—	—
Total			10.32	15.30	15.81	
			Alternative A			
Cotton	24.5	441.0	14.70	14.70	14.70	61.3
Corn	12.0	96.0	9.60	4.80	4.80	36.0
Pasture	24.0		14.40	14.40	14.40	36.0
White clover		72.0	—	—	—	—
Bermuda		120.0	—	—	—	—
Oats	24.0	2,688.0	10.80	14.40	14.40	36.0
Vetch	24.5	735.0	3.60	—	—	—
Soybeans	24.0	1,080.0	—	14.40	14.40	—
Total			53.10	62.70	62.70	169.3
			Alternative B			
Cotton	24.5	441.0	14.70	14.70	14.70	61.3
Corn	16.3	130.4	13.04	6.52	6.52	48.9
Oats	6.4	614.4	3.84	3.84	3.84	16.0
Corn and soybeans	31.2	1,185.6	24.96	12.48	6.24	46.8
Pasture	6.0		.90	—	—	12.0
White clover		30.0	—	—	—	—
Vetch	24.5	735.0	—	—	—	—
Total			57.44	37.54	31.30	185.0
			Alternative C			
Cotton	24.5	441.0	14.70	14.70	14.70	61.3
Corn	24.5	196.0	19.60	9.80	9.80	73.5
Soybeans	15.0	675.0	3.00	9.00	6.00	22.5
Pasture	20.5		24.60	12.30	8.20	41.0
Oats		2,296.0				
Crimson clover						
Rye grass		30.75	—	—	—	—
Vetch	24.5	735.0	—	—	—	—
Total			61.90	45.80	38.70	198.3

Under the present organization the fields are irregular in shape and vary in size, with the same crop being grown in separated fields. Under alternative organizations the fields will be rectangular and crops will be grown in single fields. This will facilitate cultivation and harvesting. The varying size of the fields in the alternative organization will require a rotaton program that will be composed of fields 1, 2 and 3. This system will require four years. Because of the difference in the sizes of fields 1 and 2, in the second year of the rotation the same crop will be grown on part of the previous year's acreage. In the fourth year the pasture will enter the rotation and this will necessitate a change in the field layout in the alternatives. Pastures will be clipped and fertilized each year to provide adequate feed for the livestock. The livestock enterprise will be intensified to more adequately utilize the pasture.

Production Practices

Fertilizer and Lime: Soil samples were taken from each field and tested by the Soil Testing Laboratory to determine the amount of fertilizer and lime to use for crops grown on that particular field. Fertilizer and lime were applied as recommended except for the pasture in alternative "C", where nitrogen was increased by 40 pounds per acre to provide for heavy grazing. Table 22 shows the amounts of fertilizer and lime for the present and alternative organizations. Fertilizer is expressed in pounds of nitrogen, phosphate and potash and not in pounds of complete fertilizer. Phosphate will remain the same as now used for cotton but will be increased for the other alternatives, except for the pasture in plan "B". Potash will be decreased for cotton but increased in the other enterprises. No lime is used in the present organization. In each alternative lime will be used. Soil tests indicate the acidity of the soil ranged from medium acid to very strongly acid. The pH of the top soil ranged from 4.9 to 5.8 and the pH of the subsoil ranged from 4.9 to 5.2. Increases in the amounts of fertilizer and lime are a major change in production practices in the several alternatives (Table 22).

TABLE 23.—Estimated Total Feed Requirements for Present and Alternative Organizations

Kind	Unit	Present	A	B	C
Corn	bu.	4.8	81.4	815.3	—
Oats	bu.	8.4	182.4	46.2	—
Protein supplement	cwt.	—	—	12.9	—
Pig starter	cwt.	—	—	5.9	—
Hay	ton	—	3.0	—	10.2
Cottonseed meal	cwt.	—	5.9	—	40.8
Broiler feed	cwt.	2,053.0	2,026.0	2,026.0	2,026.0

TABLE 24.—Estimated Average Crop and Livestock Production per Acre and per Head for Present and Alternative Organizations

Crops	Unit	Present Organization	A	B	C
Cotton	bales	.75	1	1	1
Corn	bu.	20	50	50	50
Oats	bu.	50	50	60	—
Wheat	bu.	32	—	—	—
Soybeans	bu.	turned under	25	—	—
Corn & soybeans	bu.	—	—	50	—
Livestock					
Beef calves	lbs.	450	550	—	357
Broilers	lbs.	3	3	3	3
Milk	qts.	1,825	1,825	—	—
Cull cows	lbs.	950	—	—	—
Market hogs	lbs.	—	—	208	—
Cull sows	lbs.	—	—	400	—
Lambs	lbs.	—	85	—	—
Wool	lbs.	—	6	—	—

Seeding Rates: The seed required for each enterprise is shown in Table 22. Several practices may be used to reduce seed requirements. Use of improved varieties, seed treatment, changes in the planting dates and the use of seed with higher germination percentages are examples. Seed requirements for the cotton, corn and oat enterprises have been reduced for the alternative organizations.

Feed Requirements: Feed requirements are shown in Table 23. In plan "A" feeding rates will be increased for the beef enterprise. Corn is increased from .68 to 4.00 bushels and oats from 1.2 to 10.8 bushels per head for the beef calves. Thirty pounds of cottonseed meal per head will be fed. The increase in feed along with other management practices should result in beef calves weighing 550 pounds when marketed in about nine months. Sufficient corn, oats, hay and pasture are produced for sheep, beef cattle and hogs in the three alternatives (Table 28). Corn will be purchased for the broiler enterprise only (plan "A", 1,880; plan "B", 2,399, and plan "C", 1,174 bushels, Table 28). The broiler feed will be custom mixed.

Crop and Livestock Yields

Crop Yields: Expected yields are presented in Table 24. Major increases over present yields are expected in the cotton and corn enterprises. Cotton yields are expected to increase by .25 bale per acre and corn by 30 bushels per acre. In each of these enterprises additional fertilizer is used and lime will be applied. Defoliation will be used for cotton in the alternatives, to facilitate mechanical harvesting and reduce price loss caused by reduction in grade when cotton is ginned.[8] Oat yield will be increased in plan "B". The oats are grown alone and will not be heavily grazed by livestock as in the other alternatives.

Livestock Yields: Table 24 presents estimated production per head of livestock. Under the present organization beef calves weigh 450 pounds when marketed at nine months of age. Under plan "B" the beef calves will weigh 550 pounds when marketed at nine months of age. This increase in production is expected from better pastures, feeding more grain and other improved practices. In plan "C" the beef calves will be bought at 450 pounds in October and sold in May at a weight of 807 pounds. In this alternative the calves are winter grazed on an oat and rye grass pasture. Broilers under each alternative will gain three pounds per bird. Feed to obtain this weight will be decreased in the alternatives from 3 pounds per pound of gain to approximately 2.8 pounds per pound of gain. With improved pastures and adequate feeding, the lambs in plan "A" are expected to weigh 85 pounds each when marketed at six months of age. The breeding flock will be sheared and will yield six pounds of wool per head. In plan "B" market hogs are sold at 208 pounds each. The hogs are provided a clover pasture and feed. While on pasture the hogs are expected to reach a weight of 75 pounds each. An additional gain of 133 pounds each is expected from hogging-off corn and soybeans.

Labor and Power Requirements

For each plan and enterprise the labor and power requirements are shown in Table 25. Approximate distribution by months is shown in Table 26. The primary source of labor is the family. Family labor available per year is 2,804 hours. Total family labor available would be sufficient for requirements in each alternative if the labor requirement were evenly distributed over the year. Table 27 shows the amount of labor and power that will be custom hired. In plan "A" the amount of labor and power custom hired and hired on a per-hour basis exceeds the requirements in the present organization. In plans "B" and "C" the amount of man-hours hired is less than in the present organization. Tractor hours for plan "C" exceed the tractor hours under the present organization.

Although total labor requirements increase over the present organization in each of the alternatives, available family labor is not fully employed. Full employment of available labor may not be possible, since labor is only one factor to consider when planning a farm. Labor

---

[8] This may not be necessary for modern gins.

TABLE 25.—Estimated Annual Labor and Power Requirements for Present and Alternative Organizations[1]

	Present		A		B		C	
Crops	Man	Power	Man	Power	Man	Power	Man	Power
	Hours							
Cotton	541.5	321.0	558.4	343.5	558.4	343.5	558.4	343.5
Corn	270.1	151.1	197.0	103.4	267.6	140.5	402.3	211.2
Soybeans	85.4	85.4	192.0	165.6	—	—	129.0	112.5
Oats	50.0	39.0	132.0	103.2	33.3	25.6	—	—
Wheat	50.0	39.0	—	—	—	—	—	—
Pasture	10.3	10.3	130.6	130.6	19.8	19.8	86.3	86.3
Corn & soybeans	—	—	—	—	219.7	219.7	—	—
Livestock								
Broilers	751.8	2.0	1,038.1	4.0	1,038.1	4.0	1,038.1	4.0
Beef cattle	123.0	—	53.7	—	—	—	84.5	—
Hogs	—	—	—	—	540.0	—	—	—
Sheep	—	—	188.6	—	—	—	—	—
Total required	1,882.1	647.8	2,490.4	850.3	2,676.9	753.1	2,298.6	757.5
Family labor available	2,804.0	—	2,804.0	—	2,804.0	—	2,804.0	—
Hire[1]	295.6	63.1	327.4	86.1	277.5	58.7	287.8	65.4

[1] Does not include seasonal labor. Thus "hired" labor is somewhat *understated* here. Seasonal labor is included in Appendix Table B-1.

TABLE 26.—Labor and Power Requirements by Months, Present and Alternative Organizations[1]

	Present		A		B		C	
Month	Man	Tractor	Man	Tractor	Man	Tractor	Man	Tractor
	Hours							
Jan.	102.6	19.5	221.7	80.5	297.9	110.9	229.5	109.8
Feb.	123.9	49.0	143.9	47.3	197.6	50.5	175.2	95.5
Mar.	96.7	52.5	156.7	84.3	232.1	129.2	162.7	97.6
Apr.	178.7	104.8	177.7	53.1	198.6	68.8	155.6	41.2
May	343.9	51.8	345.6	178.8	227.6	97.2	153.9	53.2
June	132.6	56.0	365.7	26.6	391.6	65.7	382.1	83.8
July	130.1	56.0	157.7	75.9	172.8	60.1	156.4	71.3
Aug.	126.5	43.6	192.4	68.6	204.8	44.8	154.5	48.5
Sept.	307.0	108.2	329.1	113.1	412.3	97.1	402.5	106.3
Oct.	110.1	37.8	234.7	89.0	160.4	26.8	174.9	48.3
Nov.	149.7	68.6	82.8	2.0	95.0	2.0	79.7	2.0
Dec.	80.3	—	82.3	—	86.1	—	71.6	—
Total	1,882.1	647.8	2,490.4	850.3	2,676.9	753.1	2,298.6	757.5

[1] Includes all labor.

TABLE 27.—Man-Hours and Tractor Hours Custom Hired in Present and Alternative Organizations

	Present		A		B		C	
Enterprise	Man	Tractor	Man	Tractor	Man	Tractor	Man	Tractor
Cotton	269.6	49.1	269.8	54.9	269.8	54.9	269.8	54.9
Oats	13.0	7.0	128.8	14.4	7.7	3.8	—	—
Wheat	13.0	7.0	—	—	—	—	—	—
Soybeans	—	—	28.8	16.8	—	—	18.0	10.5
Total	295.6	63.1	327.4	86.1	277.5	58.7	287.8	65.4

should be employed in those enterprises and at those times that will result in the highest returns to the farm as a unit. Various dates of performing certain operations have been changed in the alternatives to more fully utilize the available labor. When labor is not being used on a specific operation, records can be kept and miscellaneous jobs done.

Total power requirements have increased for each alternative. The increase in requirements is due to the various operations that were not done in the present organization. Total power available is adequate to meet the requirements, but some operations will be custom hired in the alternative plans because they can be done at a lower cost in this way.

Production and Disposition of the Products

Crops: Crop production and disposition is shown in Table 28. The products will be sold or used on the farm. Where products are used as feed by livestock an appropriate charge is made against that enterprise in computing costs and returns. The charge made to the livestock enterprise is the price that would have been received for the product if sold. This is necessary to determine the relative profitability of the enterprises. The "value" of the products shown in this table is not the net returns. To determine net returns from the various enterprises, expenses must be considered.

Under the present organization cotton, corn, oats, wheat and cotton seed are sold. Under plan "A" cotton, oats, soybeans and cotton seed are sold. Cotton, oats and cotton seed are sold under plan "B", and under plan "C" cotton, corn, soybeans and cotton seed are sold. The amounts sold under the present and alternative organizations will vary because of differences in crops, crop acreages and the amount used for seed. Cotton and cotton seed are exceptions; the quantity sold is the same for the alternatives but differs from that sold under the present organization because of an increase in yields for the alternatives.

Livestock: The estimated production and disposition of livestock products is shown in Table 29. Broilers will be produced under present and alternative organizations. Beef is produced under the present organization and under plans "A" and "C". Hogs are produced in plan "B" and sheep in plan "A". The amount of livestock products produced and sold will differ because of differences in kinds, number, replacement needs, home use and death losses. The value shown in Table 29 is the gross sales value and not the net returns from the individual enterprises. The value of broilers sold under the alternative organizations will be the same but will differ from the value under the present

TABLE 28.—Estimated Production and Disposition of Crops, Present and Alternative Organizations

Crop	Unit	On Hand	Purchased	Produced	Feed	Sale	Receipts	
							Price	Value
				Present Organization				
Cotton	bales	—	—	18.4	—	18.4	$160.00	$2,940.
Corn	bu.	300	—	390.0	4.8	685.2	1.20	828.[1]
Oats	bu.	350	—	500.0	8.4	841.6	.86	731.[1]
Wheat	bu.	—	—	320.0	—	320.0	1.95	624.
Soybeans[2]	bu.	—	—	—	—	—	—	—
Cotton seed	ton	—	—	7.1	—	7.1	50.99	362.
				Alternative A				
Cotton	bales	—	—	24.5	—	24.5	160.00	3,920.
Corn	bu.	—	1,880.0	600.0	600.0	—	1.20	720.
Oats	bu.	—	—	1,200.0	182.4	1,017.6	.86	1,032.
Cotton seed	ton	—	—	11.5	—	11.5	50.99	586.
Soybeans	bu.	—	—	600.0	—	600.0	1.95	1,170.
				Alternative B				
Cotton	bales	—	—	24.5	—	24.5	160.00	3,920.
Corn	bu.	—	2,399	815.0	815.3	—	1.20	978.
Oats	bu.	—	—	384.0	46.2	337.8	.86	291.
Corn & beans[3]	bu.	—	—	—	—	—	—	—
Cotton seed	ton	—	—	11.5	—	11.5	50.99	586.
				Alternative C				
Cotton	bales	—	—	24.5	—	24.5	160.00	3,920.
Corn	bu.	—	1,174	1,225.0	—	—	1.20	1,470.
Soybeans	bu.	—	—	375.0	—	375.0	1.95	731.
Cotton seed	ton	—	—	11.5	—	11.5	50.99	586.

[1] This is the value of the product produced and on hand. The amount used as feed is charged to the applicable enterprise. Any discrepancy when multiplying quantity and price results from rounding.

[2] Turned under.

[3] Hogged off.

TABLE 29.—Estimated Production and Disposition of Livestock and Livestock Products, Present and Alternative Organizations

Item	Unit	On Hand	Purchased	Produced	Home Use	Loss	Replacement	Sales	Receipts	
									Price	Value[1]
Present Organization										
Milk cows	each	2	—	—	—	—	—	—	—	—
Bulls	each	1	—	—	—	—	—	—	—	—
Beef cows	each	9	—	—	—	—	—	—	—	—
Calves	each	7	—	—	1	—	—	6	71.10	427.
Broilers	each	5,000	20,000	—	100	2,087	—	22,813	.57	13,003.
Milk	qts.	—	—	1,825	1,825	—	—	—	—	—
Horse	each	1	—	—	—	—	—	—	—	—
Shetland pony	each	1	—	—	—	—	—	—	—	—
Alternative A										
Bulls	each	1	—	—	—	—	—	—	—	—
Beef cows	each	9	—	—	—	—	—	—	—	—
Beef calves	each	—	—	8	1	—	—	7	86.90	608.
Broilers	each	5,000	20,000	—	100	640	—	24,260	.57	13,828.
Ewes	each	—	70	—	—	—	7	7	8.78	61.
Lambs	each	—	—	84	—	4	7	73	14.49	1,058.
Rams	each	—	2	—	—	—	—	—	—	—
Wool[2]	lbs.	—	—	430	—	—	—	—	.49	211.
Alternative B										
Broilers	each	5,000	20,000	—	100	640	—	24,260	.57	13,828.
Sows	each	—	12	—	—	—	6	6	61.24	367
Boars	each	—	1	—	—	—	—	—	—	—
Market hogs	each	—	—	168	—	8	6	154	38.33	5,904.
Alternative C										
Broilers	each	5,000	20,000	—	100	640	—	24,260	.57	13,828.
Beef calves	each	—	34	—	1	1	—	32	142.27	4,553

[1] Rounded.

[2] Wool incentive payment not included.

TABLE 30.—Estimate of Products Used in Home, Present and Alternative Organizations

		Present		A		B		C	
Item	Unit	Amt.	Val.	Amt.	Val.	Amt.	Val.	Amt.	Val.
Milk	qts.	1,825	$493	1,825	$493	—	—	—	—
Beef	lbs.	450	$ 71	550	$ 87	—	—	—	$97
Broilers	lbs.	300	$ 63	300	$ 63	300	$63	300	$63

TABLE 31.—Summary of Annual Crop and Livestock Expense, by Enterprise, for Present and Alternative Organizations[1]

	Present	A	B	C
Crops				
Cotton	$ 1,992.83	$ 2,232.93	$ 2,232.93	$ 2,232.93
Corn	128.32	295.80	401.80	603.93
Oats	244.10	—	—	—
Wheat	240.50	—	—	—
Soybeans	96.18	651.60	—	400.35
Oats	—	854.64	—	—
Corn & soybeans	—	—	808.09	—
Pasture	6.08	516.96	53.34	734.11
Total crop	$ 2,708.01	$ 4,551.99	$ 3,703.97	$ 3,971.32
Livestock				
Broilers[2]	$15,462.79	$12,719.49	$12,719.49	$12,719.49
Sheep[2]	—	469.47	—	—
Beef cattle	39.33	193.36	—	713.04
Hogs[2]	—	—	2,652.33	—
Total livestock	$15,502.12	$13,382.32	$15,371.82	$13,432.53
Total	$18,210.13[1]	$17,934.31[1]	$19,075.63[1]	$17,403.85[1]

[1] Table 35 provides a more complete picture of total expenses for the *whole farm.* Table 31 excludes family labor and some seasonal labor and depreciation items. Family labor is not a cash cost. Seasonal labor not included here because it could not be allocated by crops, since seasonal peaks occur concurrently. These totals are in error by this amount. They differ from those in Table 35, where charges for seasonal labor are included.

[2] Includes only depreciation that can be *directly* apportioned to an enterprise. Other depreciation allocated to *whole farm* in Table 35.

organization. This results from a difference in the death loss between the present and alternative organizations.[9]

Home-used Products: The value of products used at home should be credited to the enterprise producing the product, since expenses were charged to the particular enterprise. In both present and alternative organizations some livestock products are used in the home. Table 30 shows the kind, amount and value of these products.

---

[9] The chicks (1,437) lost because of the hurricane are not included in death loss. See footnote 5, Table 15.

Expenses and Receipts

Expenses: *Most* (but not all) of the crop and livestock enterprise expenses are summarized by enterprises in Table 31.[10] In each of the alternative organizations the crop expenses increase over the current organization (in plan "A" by $1,843.98, "B" by $995.96 and plan "C" by $1,263.31). Major crop expenses in the present organization are for cotton and oats; in plan "A", cotton, oats, soybeans and pasture. In plans "B" and "C", cotton, corn and pasture require the major expenses. The livestock expenses for plans "A", "B" and "C" are lower than for the present organization, by $2,119.80, $130.30, and $2,069.59 respectively. Total expenses (crop and livestock) for plan "B" are higher than for the present organization by $865.50. Total expenses (crop and livestock) for plans "A" and "C" are lower than for the present organization. *Cost of family and seasonal labor are not included in this table*

TABLE 32.—Estimated Annual Receipts from Crops and Livestock, by Enterprise, for Present and Alternative Organizations

	Present	A	B	C
Crops				
Cotton	$ 2,940 00	$ 3,920.00	$ 3,920.00	$ 3,920.00
Cotton seed	362.36	587.27	587.27	587.27
Oats[1]	731.00	1,032.00	330.24	—
Wheat	624.00	—	—	—
Soybeans	—	1,170.00	—	731.25
Corn[1]	828.00	720.00	978.00	1,470.00
Total crops	$ 5,485.36	$ 7,429.27	$ 5,815.51	$ 6,708.52
Livestock				
Broilers	$13,003.41	$13,828.20	$13,828.20	$13,828.20
Sheep[2]	—	1,417.20	—	—
Hogs	—	—	6,270.94	—
Beef cattle	426.60	608.30	—	4,559.28
Total livestock	$13,430.01	$15,853.70	$20,099.14	$18,387.48
Total	$18,488.77	$23,282.97	$25,914.65	$25,096.00

[1] Includes 350 bushels of oats and 300 bushels of corn on hand at the beginning of the year under present organization.

[2] Includes $87.06 ASC incentive payment.

---

[10] Family labor and some seasonal labor costs and depreciation items are not included here. Family labor is not a cash cost. Seasonal labor was not allocated by enterprises. Table 36 gives a more complete summary of expenses for the whole farm.

(31). Any depreciation that can be directly apportioned is included in these expenses. Additional depreciation cost is included in the summary of receipts and expenses for the whole farm in Table 35.

Receipts: Estimated annual gross receipts for the present and alternative organizations are shown in Table 32. Total receipts from crops and livestock are expected to increase in plan "A", which has a cotton, corn, oat, and soybean rotation. Plan "C", with a cotton, soybean, and corn rotation, yields the third highest return, followed by plan "B" and the present organization. Livestock receipts also increase. Plan "B" yields the highest gross livestock returns, followed in order by plan "C", "A" and the present organization. These receipts are gross receipts and not net receipts. To obtain net receipts the expenses must be subtracted. (See Table 36.)

TABLE 33.—Estimated Capital Investment for Present and Alternative Organizations

	Present	A	B	C
Machinery	$ 2,437.06	$ 2,437.06	$ 2,437.06	$ 2,437.06
Small equipment	250.00	250.00	250.00	250.00
Tool shed	533.34	533.34	533.34	533.34
Fence	250.00	1,117.45	700.38	250.00
Broiler house[1]	3,267.72	3,267.72	3,267.72	3,267.72
Livestock[2]	540.00	1,295.25	870.00	2,059.47
Sheep equipment	—	450.00	—	—
Hog equipment	—	—	997.57	—
Land	6,975.00	6,975.00	6,975.00	6,975.00
Total	$14,253.12	$16,325.82	$16,031.07	$15,772.59
Interest @ 5%	$ 712.66	$ 816.29	$ 801.55	$ 842.39

[1] Includes other equipment for the broiler enterprise.
[2] Excludes broilers.

TABLE 34.—Estimated Increase in Capital Investment for Alternative Organizations Over the Present Organization

	A	B	C
Fences	$ 867.45	$ 450.38	———
Sheep equipment	450.00	———	———
Hog equipment	———	———	———
Livestock			
Sheep	755.25	———	———
Hogs	———	330.00	———
Beef cattle	———	———	2,059.47
Total	$2,070.70	$1,777.95	$2,059.47

TABLE 35.—Summary of Total Expenses and Receipts, by Kind, Present and Alternative Organizations, Whole Farm

Item	Present	A	B	C
Cash Receipts				
Crops	$ 5,485.36	$ 7,429.27	$ 5,815.51	$ 6,708.52
Livestock	13,430.01	15,853.70	20,099.14	18,387.48
	549.04[1]	—	—	—
Total crop & livestock	$19,464.41	$23,282.97	$26,069.50	$25,441.25
Expenses[2]				
Fertilizer & lime	$ 406.48	$ 1,794.91	$ 1,331.95	$ 1,515.29
Spraying & worming	—	14.57	4.14	—
Seed	382.50	377.21	318.19	338.72
Broiler feed	11,496.80	8,752.32	8,752.32	8,752.32
Cottonseed meal	—	23.79	—	163.20
Chicks	3,050.00	3,050.00	3,050.00	3,050.00
Protein supplement	—	—	671.05	—
Veterinary	—	18.54	65.16	35.02
Insurance	140.00	140.00	140.00	140.00
Custom work	682.63	1,106.50	758.50	823.00
Hired labor	147.10	170.10	202.60	145.10
Oystershell flour	—	11.38	5.00	6.46
Steamed bone meal	—	31.85	14.00	18.10
Salt	3.29	16.36	2.98	6.90
Insecticide	470.40	318.50	318.50	318.50
Defoliate	—	67.38	67.38	67.38
Pre-emerge	63.70	63.70	63.70	63.70
Power	351.86	428.21	416.39	415.39
Hauling	156.00	158.00	150.00	182.00
Livestock feed	12.98	334.80	1,341.56	269.28
Marketing	17.06	77.54	250.84	182.08
Repairs	342.83	377.86	376.30	342.83
Depreciation[3]	416.13	506.13	615.13	416.13
Depreciation[4]	492.93	550.76	522.96	429.93
Fence[5]	—	69.68	30.03	—
Ginning	240.84	321.20	321.20	321.20
Interest on investment[6]	712.66	816.29	801.55	842.39
Miscellaneous[7]	328.68	328.68	426.76	328.68
Total	$19,914.87	$19,926.26	$ 21,018.19	$19,236.60

[1] The net returns ($549.04) have been included here from the broilers that were lost because of a hurricane.

[2] Excludes family labor.

[3] Depreciation for broilers, sheep and hogs that can be directly apportioned.

[4] Depreciation that cannot be directly apportioned to any one enterprise.

[5] Fence cost only. Prorated over a 15-year period (alternative "A", $1,045.25; alternative "B", $450.38).

[6] Interest on investment at 5 per cent. See Table 33. Dwelling was omitted.

[7] For example, electricity and litter for the broilers were included under miscellaneous expense.

Capital Requirements

Capital requirements for the present and alternative organizations are shown in Table 33. Capital requirements increase over the present organization for each alternative. The increase is largest for plan "C", followed by plans "A" and "B". Table 34 shows the change in capital requirements. These changes are due to the requirements of the different classes of livestock in the alternatives. Plan "A" will require $2,070.70 additional capital. Fences, sheep equipment and the purchase of a sheep breeding flock account for the addition. Under plan "B" an increase of $1,777.95 is required. Fences, hog equipment and the purchase of 12 brood sows and a boar account for the increase. Plan "C" will require an additional investment of $2,059.47 to purchase 34 head of calves for winter grazing.

Summary of Expenses and Receipts

A summary of expenses and receipts for the present and alternative organizations is shown in Table 35. An analysis of this part of the farm plan will indicate which alternative to select, assuming maximum net income is the farm goal. Under each alternative the cash receipts from crops and livestock increase over the present organization. These increases are primarily due to yield increases resulting from an improved level of practices. Improved practices include: increased use of fertilizer, liming as recommended, more timely operations which more evenly distribute family labor over the year, and improved feeding levels. Expenses increase under plan "A" and "B" but decrease slightly under plan "C". The major expense item under present and alternative organizations is broiler feed. Under the present organization 57.7 per cent of the expenses are for broiler feed (plan "A", 43.9 per cent; plan "B", 41.6 per cent; plan "C", 45.5 per cent). Other major expense items are chicks, fertilizer, lime and custom work.

Table 36 presents a summary of *net* cash receipts for the present and alternative organizations. For comparison purposes $549.04 is added to

TABLE 36.—Summary of Receipts for Present and Alternative Organizations

Item	Present	A	B	C
Net receipts	$—450.46[1]	$3,356.71	$5,051.31	$6,204.65
Home used products	$ 626.85	$ 643.75	$ 63.00	$ 159.97
Return to family for labor and management	$ 176.39	$4,000.46	$5,114.31	$6,364.62

[1] This includes $549.04 net returns that would have been received from the broilers that were lost because of the hurricane. Since the probability of this type of loss is extremely small it is necessary to include the potential returns in order to make comparisons of net returns to the various plans.

the present organization. This is the net return that would have been received from the broilers that were lost (during the hurricane).

From an analysis and comparison of the present organization and three alternatives, and the assumption that the farm goal is maximum net farm income, plan "C" is the most profitable system of farming (among those studied) for this farm.

APPENDIX

APPENDIX TABLE A-1.—Labor and Power Requirements per Acre for Establishing and Maintaining White Clover Pasture[1]

Operation	Times Over	Man-hours	Tractor Hours
Disc	2	1.00	1.00
Lime[2]	1	.60	.60
Harrow	1	.50	.50
Plant	1	.70	.70
Clip	1	.50	.50
Total		3.30	3.30

[1] Computed from Appendix Table B-9.

[2] Prorated over an 8-year period. Further applications will be made when indicated as necessary by a soil test.

APPENDIX TABLE A-2.—Estimated Cost per Acre for Establishing and Maintaining a White Clover Pasture

Item	Unit	Amount	Price/Unit	Total Cost
Seed				
White clover	lb.	5	.856	$ 4.28
Fertilizer				
Ammonium nitrate	cwt.	.45	4.12	1.85
Lime[1]	ton	2	6.50	.81
Labor[2]	hrs.	3.30	.50	1.65
Power[2]	hrs.	3.30	.59	1.95
Total				$10.54

[1] Prorated over an 8-year period. Federal cost-share, $6.50 per acre under the Soil Conservation Program.

[2] See Appendix Tables B-1 and B-2.

APPENDIX TABLE A-3.—Labor, and Power Requirements per Acre of Corn and Soybeans for Hogging-off[1]

Operation	Times Over	Man-hours	Tractor Hours
Disc	2	1.00	1.00
Bed rows	1	.50	.50
Disc rows	1	.50	.50
Lime[2]	1	.60	.60
Fertilize	1	.60	.60
Rebed	1	.50	.50
Harrow	1	.32	.32
Plant	2	1.00	1.00
Cultivate	4	2.00	2.00
Total		7.02	7.02

[1] Computed from Appendix Table B-9.

[2] Prorated over an eight-year period. Further applications will be made when indicated as necessary by a soil test.

APPENDIX TABLE A-4.—Estimated Cost per Acre for Corn and Soybeans for Hogging-off Operation

Item	Unit	Amount	Price/Unit	Total Cost
Seed[1]				
Corn	lbs.	8.0	$ .207	$ 1.66
Soybeans	lbs.	30.0	.089	2.67
Fertilizer[2]				
Ammonium nitrate	cwt.	1.82	4.12	7.50
5-10-5	cwt.	4.00	2.33	9.32
Lime[3]	tons	1.5	6.50	.61
Labor[4]	hrs.	7.02	.50	3.51
Power[4]	hrs.	7.02	.59	4.14
Total				$29.41

[1] Luno, G. A., *Swine Raising Plan for Franklin Parish,* Louisiana Extension Service, Louisiana State University, p. 3.

[2] Fertilizer applied as recommended by the Soil Testing Laboratory, Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana.

[3] Prorated over an 8-year period. Further applications will be made when indicated as necessary by a soil test. Federal cost-share, $3.25 per ton.

[4] See Appendix Tables B-1 and B-2.

APPENDIX TABLE A-5.—Feed, Labor, Land and Power Requirements for Two Sows, One Boar and Fourteen Pigs

	Unit	Amount	Total
Feed[1]			
Sow			
Corn	bu. per head	50.64	101.28
Oats	bu. per head	.45	.90
Protein supplement	lbs. per hd.	264.80	529.60
Pigs			
Corn	bu. per hd.	1.10	15.40
Oats	bu. per hd.	.12	1.66
Protein supplement	lbs. per hd.	57.90	810.60
Starter	lbs. per hd.	35.00	490.00
Boar			
Corn	bu. per hd.	—	22.9
Oats	bu. per hd.	—	20.6
Labor			
Hogs[2]	hrs. 2 litters	—	45.00
Pasture[3]	hrs. per acre	3.30	3.30
Corn and beans[4]	hrs. per acre	7.02	18.25
Land			
Pasture	acres per litter	.50	1.00
Corn and beans	acres per litter	1.30	2.60
Power			
Pasture[3]	hrs. per acre	3.30	3.30
Corn and beans[4]	hrs. per acre	7.02	18.25

---

[1] Deyoe, G. P., and Krider, J. L., *Raising Swine* (New York: The McGraw-Hill Book Company, 1952), p. 128. Feed was calculated to provide the following percentages of protein: bred sow 11 per cent, lactating sow 12 per cent, pigs 16 per cent and boar 11 per cent.

[2] *Illinois Farm and Home Development Reference Book,* University of Illinois, Extension Service, p. 24. For an 11-15 sow herd 60 hours were required. Because of earlier pastures in Louisiana and hogging-off corn and beans, 45 hours per sow and litters is used.

[3] See Appendix Tables A-1 and A-3.

[4] See Appendix Tables A-1 and A-3.

APPENDIX TABLE A-6.—Estimated Cost and Returns from Hog Enterprise[1]

Item	Unit	Amount	Price/Unit	Total Cost & Returns
Corn and beans[2]	acre	31.30	$29.41	$ 920.53
Pasture[3]	acre	6.00	10.54	63.24
Feed				
Corn	bu.	815.38	1.20	978.46
Oats	bu.	46.16	.86	39.70
Supplement	lbs.	12,904.80	.052	671.05
Starter	lbs.	5,880.00	.055	323.40
Worming[4]	lbs.	8.42	.32	2.69
Medicine & veterinary[5]	—		.36	65.16
Vaccination[6]	cc	5,880.00	4.17	98.08
Oystershell flour[7]	cwt.	4.00	1.25	5.00
Steamed bone meal[7]	cwt.	4.00	3.50	14.00
Salt[7]	cwt.	2.00	1.49	2.98
Spray[8]	lbs.	14.48	.10	1.45
Marketing[9]	4%	—	—	250.84
Bldg. & equipment[10]	—	—	—	199.52
Labor	hrs.	540.00	.50	270.00
Total				3,906.10
Returns				
Hogs[11]	cwt.	320.32	18.43	$5,903.50
Sows[11]	cwt.	24.00	15.31	367.44
Total				$6,270.94
Net returns				$2,364.84

[1] Hog enterprise consists of 12 brood sows, 1 boar, 168 pigs.

[2] One acre of corn and beans at 50 bushels per acre should finish 5.37 pigs to a weight of 208 pounds each, or a gain of 133 pounds each.

[3] Luno, G. A., *Swine Raising Plan for Franklin Parish,* Louisiana Extension Service. One-half acre per sow and litter is recommended.

[4] Sodium fluoride is used in a mix of one pound sodium fluoride per 100 pounds of feed. Wormed twice.

[5] Veterinary cost per head taken from survey data of the Department of Agricultural Economics, Louisiana State University.

[6] One cc per pound of live weight recommended by A. D. Fitzgerald, Associate Animal Husbandman, Louisiana Extension Service, in a circular letter to all agents, February 25, 1957, $4.17 per 250 cc.

[7] *Reference Manual-Farm and Home Development* recommends 500 pounds for 6 sows and litter and 1 boar. The ratio is 40-40-20.

[8] Benzene hexachloride, 6 per cent gamma used. Sprayed two times. Two pounds BHC per 25 gallons of water.

[9] Four per cent of gross sales.

[10] Includes waterers, farrowing house, troughs, feeders, mineral boxes and wallows. Total cost of $997.59 prorated over a 5-year period.

[11] 154 market hogs sold at 208 pounds each. Six gilts saved for replacement and assumed 8 death loss. 1953-57 average price for March and August good and choice barrows and gilts was $17.40 and $19.35; the 5-year overall average was $18.43. For sows the 5-year average was $15.31.

APPENDIX TABLE A-7.—Estimated Cost and Returns per Acre of Soybeans, Present and Alternative Organization "C"[1]

Item	Unit	Amount Present	Amount Alternative	Price/ Unit	Total Cost & Returns Present	Total Cost & Returns Alternative
Seed	lbs.	30	45[2]	.083	2.49	3.74
Fertilizer[3]						
Ammonium nitrate	cwt.	—	.31	4.12	—	1.28
Superphosphate	cwt.	.30	1	1.62	.49	1.62
Muriate of potash	cwt.	.11	—	2.65	.29	
3-12-12	cwt.	—	3.33	2.38	—	7.93
Lime[4]	ton	—	1.5	6.50	—	.61
Labor[5]	hr.	6.10	7.40	.50	3.05	3.70
Power	hr.	6.10	6.80	.59	3.60	4.01
Custom work	acre	—	—	7.50	—	7.50
Total					$9.92	$30.39
Returns						
Soybeans	bu.	—	25	1.95	—	$48.75
Net returns						$18.36

[1] Under present organization soybeans are turned under. For alternative organization soybeans will be harvested and sold.

[2] Forty-six to 60 pounds per acre is recommended in *Louisiana Soybeans,* Wasson, R. A., Killgore, A. G., Agr. Extension Pub. 1183, Louisiana Extension Service, March 1955, p. 5.

[3] As recommended by the Soil Testing Laboratory, Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana. Superphosphate and muriate of potash used. In alternative, ammonium nitrate, 3-12-12 and superphosphate will be used.

[4] Prorated over an 8-year period. Federal cost-share, $4.87 per acre under the Soil Conservation Program.

[5] See Table 11; 1.20 man-hours and .70 tractor hour included with custom work.

APPENDIX TABLE A-8.—Estimated Labor and Power Requirements per Acre of Oats and Rye Grass Pasture Combination

Operation	Times Over	Man-hours	Tractor Hours
Discing	2	1.00	1.00
Harrowing	1	.32	.32
Planting	2	.60	.60
Cultipacking	1	.49	.49
Liming	1	.45	.45
Fertilizing[1]	3	1.35	1.35
Total		4.21	4.21

[1] Fertilizer will be in three applications.

APPENDIX TABLE A-9.—Estimated Cost per Acre of Oats and Rye Grass Pasture Combination for Winter Grazing

Item	Unit	Amount	Price/Unit	Total Cost
Seed				
Oats	bu.	3.5	$1.48	$ 5.18
Rye grass	lbs.	15	.11	1.65
Fertilizer[1]				
Ammonium nitrate	cwt.	2.42	4.12	9.97
8-8-8	cwt.	5.00	2.82	14.10
Phosphate 20%	cwt.	1.00	1.62	1.62
Lime[2]	ton	2	6.50	.81
Labor	hrs.	4.21	.50	2.11
Tractor	hrs.	4.21	.59	2.48
Total cost				$37.92

[1] Phosphate, potash and lime applied as recommended by the Soil Testing Laboratory, Agricultural Experiment Station, Baton Rouge, Louisiana. Nitrogen increased by 40 pounds per acre because of heavy grazing.

[2] Lime prorated over an 8-year period. Federal cost-share per acre, $16.50 under the Soil Conservation Program.

APPENDIX TABLE A-10.—Estimated Cost and Returns From Cattle Enterprise in Plan "C"

Item	Unit	Amount	Price/Unit	Total Cost
Calves[1]	cwt.	153.0	$16.99	$2,599.47
Pasture[2]	acre	20.50	37.92	777.36
Feed				
Hay	ton	10.2	26.48	269.28
CSM	cwt.	40.8	4.00	163.20
Veterinary[3]	hd.	—	1.03	35.02
Hauling	hd.	32.00	1.00	32.00
Salt	cwt.	4.63	1.49	6.90
Steamed bone meal	cwt.	5.17	3.50	18.10
Oystershell flour	cwt.	5.17	1.25	6.46
Marketing	—	—	4%	182.08
Labor	hr.	84.50	.50	42.25
Total				$4,132.12
Returns				
Calves[4]	cwt.	258.2	17.63	$4,552.07
Net returns				$ 419.95

[1] Calves will be bought in October at 450 pounds each and will be sold in May at 807 pounds each.

[2] Pasture was stocked at the rate of 1.7 calves per acre. Experimental results at the Red River Valley Agricultural Experiment Station, Bossier City, Louisiana, indicate the feasibility of this stocking rate. Wheat alone was grazed in this experiment.

[3] Includes vaccination and medicine. Price data taken from survey records.

[4] 32 sold; death loss 1; 1 used in the home.

APPENDIX TABLE B-1.—Estimated Monthly Labor Requirements for Present and Alternative Organizations

Enterprise	J	F	M	A	M	J	J	A	S	O	N	D	Total
						Present Organization							
Cotton	—	49	—	37	196	39	39	39	—	73	69	—	541.5
Corn	20	—	20	42	10	10	10	—	160	—	—	—	270.1
Soybeans	—	—	28	14	14	7	7	4	11	—	—	—	85.4
Oats	—	—	3	—	25	—	—	—	22	—	—	—	50.0
Wheat	—	—	3	—	25	—	—	—	22	—	—	—	50.0
Pasture	—	—	10	—	—	—	—	—	—	—	—	—	10.3
Livestock													
Broilers	71	63	35	68	68	70	68	71	68	35	69	68	751.8
Beef cattle	13	12	10	6	6	6	6	12	12	14	12	13	123.0
Total	103	124	109	167	344	133	130	127	295	122	150	80	1,882.1
Family labor	246	210	230	236	232	226	246	230	236	246	220	246	2,804.0
Hire	—	—	—	—	222	—	—	—	59	73	—	—	354.3
						Plan A							
Cotton	61	25	49	12	25	230	44	20	74	20	—	—	558.4
Corn	19	12	25	6	6	6	6	—	116	—	—	—	197.0
Pasture	—	11	—	35	33	14	—	—	—	38	—	—	130.6
Oats	—	—	7	—	58	—	—	31	36	—	—	—	132.0
Soybeans	—	—	—	—	98	—	12	24	—	58	-	—	192.0
Livestock													
Beef cattle	6	5	5	5	5	3	3	3	4	4	5	6	53.7
Broilers	105	67	52	102	95	102	85	106	91	106	67	59	1,038.1
Sheep	30	24	19	17	26	11	9	9	9	9	10	18	188.6
Total	222	144	157	177	346	366	159	193	330	235	82	82	2,490.4
Family labor	246	210	230	236	232	226	246	230	236	246	220	246	2,804.0
Hire	—	—	—	—	114	196	—	—	94	58	—	—	462.3

(Continued on next page)

APPENDIX TABLE B-1. (Continued)

Enterprise	J	F	M	A	M	J	J	A	S	O	N	D	Total
						Plan B							
Cotton	61	25	49	12	25	230	44	20	74	20	—	—	558.4
Corn	26	16	35	8	16	8	—	—	159	—	—	—	267.6
Oats	—	—	2	—	15	—	8	—	8	—	—	—	33.3
Pasture	—	—	—	—	3	—	—	10	—	7	—	—	19.8
Corn & soybeans	24	8	47	49	46	23	8	16	—	—	—	—	219.7
Livestock													
Broilers	105	67	52	102	95	102	85	106	91	106	67	59	1,038.1
Hogs	82	82	48	28	28	28	28	54	82	23	28	28	540.0
Total	298	198	232	198	228	391	173	215	414	160	95	86	2,676.9
Family labor	246	210	230	236	232	226	246	230	236	246	220	246	2,804.0
Hire	52	—	2	—	8	196	—	—	178	—	—	—	421.3
						Plan C							
Cotton	61	25	49	12	25	230	44	20	74	20	—	—	558.4
Corn	39	25	52	12	12	12	12	—	238	—	—	—	402.3
Soybeans	—	47	—	8	17	8	15	—	—	36	—	—	129.0
Pasture	9	—	—	9	—	30	—	29	—	9	—	—	86.3
Livestock													
Beef calves	14	12	11	12	5	—	—	—	—	4	12	13	84.5
Broilers	105	67	52	102	95	102	85	106	91	106	67	59	1,038.1
Total	230	175	163	156	154	382	147	145	365	175	80	72	2,298.6
Family labor	246	210	230	236	232	226	246	230	236	246	220	246	2,804.0
Hire	—	—	—	—	—	196	—	—	129	18	—	—	343.7

---

[1] Monthly requirements have been rounded and may not add up to the totals.

APPENDIX TABLE B-2.—Estimated Monthly Power Requirements for Present and Alternative Organizations[1]

Enterprise	J	F	M	A	M	J	J	A	S	O	N	D	Total
Present Organization													
Cotton	—	49	—	37	—	39	39	39	—	49	69	—	321.0
Corn	20	—	20	42	10	10	10	—	41	—	—	—	151.1
Oats	—	—	3	—	14	—	—	—	22	—	—	—	39.0
Wheat	—	—	3	—	14	—	—	—	22	—	—	—	39.0
Soybeans	—	—	28	14	14	7	7	4	11	—	—	—	85.4
Pasture	—	—	10	—	—	—	—	—	—	—	—	—	10.3
Livestock													
Broilers	—	—	1	—	—	—	—	—	—	1	—	—	2.0
Total	20	49	65	93	52	56	56	44	96	50	69	—	647.8
Hired	—	—	—	—	14	—	—	—	—	49	—	—	63.1
Plan A													
Cotton	61	25	49	12	25	34	44	20	55	20	—	—	343.5
Corn	19	12	23	6	6	6	6	—	25	—	—	—	103.4
Pasture	—	11	—	35	33	—	14	—	—	38	—	—	130.6
Oats	—	—	—	—	29	—	—	31	36	—	—	—	103.2
Soybeans	—	—	—	—	18	—	12	24	—	31	—	—	165.6
Livestock													
Broilers	—	—	2	—	—	—	—	—	—	—	—	2	4.0
Total	81	47	98	53	80	94	54	45	113	58	2	—	850.3
Hired	—	—	—	—	14	—	—	—	55	31	—	—	86.1

(Continued on next page)

APPENDIX TABLE B-2. (Continued)

Enterprise	J	F	M	A	M	J	J	A	S	O	N	D	Total
						Plan B							
Cotton	61	25	49	12	25	34	44	20	55	20	—	—	343.5
Corn	26	16	31	8	16	8	—	—	34	—	—	—	140.5
Oats	—	2	—	—	8	—	8	—	8	—	—	—	25.6
Pasture	—	—	—	—	3	—	—	10	—	7	—	—	19.8
Corn and soybeans	24	8	47	48	46	23	8	16	—	—	—	—	219.7
Livestock													
Broilers	—	—	2	—	—	—	—	—	—	—	2	—	4.0
Total	111	51	129	69	97	66	50	35	97	27	2	—	733.5
Hired	—	—	—	—	4	—	—	—	55	—	—	—	58.7
						Plan C							
Cotton	61	25	49	12	25	34	44	20	55	20	—	—	343.5
Corn	39	25	47	12	12	12	12	—	51	—	—	—	211.2
Soybeans	—	17	—	8	17	8	15	—	—	20	—	—	112.5
Pasture	9	—	—	9	—	30	—	29	—	9	—	—	86.3
Livestock													
Broilers	—	—	2	—	—	—	—	—	—	—	2	—	4.0
Total	110	96	98	41	53	84	62	39	106	48	2	—	737.9
Hired	—	—	—	—	—	—	—	—	55	11	—	—	65.4

[1] Monthly requirements have been rounded and may not add up to the totals.

APPENDIX TABLE B-3.—Estimated Monthly Feed Requirement for President and Alternative Organizations[1]

Item	Unit	J	F	M	A	M	J	J	A	S	O	N	D	Total
						Present Organization								
Oats	bu.	—	—	—	—	—	—	—	3	3	3	—	—	8.4
Corn	bu.	—	—	—	—	—	—	—	2	2	2	—	—	4.8
Broilers	cwt.	142	188	93	204	208	115	188	152	202	153	202	206	2,053.0
						Plan A								
Oats	bu.	41	32	11	11	11	11	30	25	—	—	—	10	182.4
Corn	bu.	18	13	6	6	6	6	11	8	—	—	—	6	81.4
Hay	ton	1	1	—	—	—	—	—	—	—	—	—	1	3.0
CSM	lbs.	61	408	—	—	—	—	62	62	—	—	—	—	593.0
Broilers	cwt.	199	127	98	193	180	193	161	200	172	201	191	111	2,026.0
						Plan B								
Corn	bu.	70	83	77	73	74	62	54	54	60	70	68	70	815.3
Oats	bu.	4	6	5	4	5	3	2	2	3	4	4	4	46.3
Supplement	lbs.	1,151	2,050	1,500	1,342	1,387	801	270	270	717	1,151	1,114	1,151	12,904.8
Starter	lbs.	—	2,940	—	—	—	—	—	—	2,940	—	—	—	5,880.0
Broilers	cwt.	199	127	98	193	180	193	161	200	172	201	191	111	2,026.0
						Plan C								
Hay	ton	—	—	—	—	—	—	—	—	—	3	5	3	10.2
CSM	cwt.	—	—	—	—	—	—	—	—	—	10	20	10	40.8
Broilers	cwt.	199	127	98	193	180	193	161	200	172	201	191	111	2,026.0

[1] Monthly requirements have been rounded and may not add up to the totals.

APPENDIX TABLE B-4.—Estimated Depreciation of Equipment and Building Used in Present and Alternative Organizations

Equipment	No.	Estimated Life, Years[1]	Present Value	Depreciation/ Year
Tractor	1	12	$1,264.85	$ 180.84
Tractor disc plow	1	15	251.34	19.33
Busters	1	15	120.00	12.00
Cultivators, tractor	1	20	187.50	12.50
Stalk cutter	1	15	13.37	3.33
Planter	1	10	80.00	16.00
Distributor	1	10	54.00	6.00
Oat drill	1	10	15.00	15.00
Truck, 1½ ton[2]	1	12	200.00	133.33
Trailer, small[3]	1	13.4	250.00	21.92
Chick waterers[4]	9	5	52.80	17.60
Chick feeders[4]	150	5	268.20	89.40
Brooders[4]	7	7	144.60	28.92
Broiler house[4]	1	12	2,802.12	280.12
Hog equipment[4]	—	5	997.57	199.51
Sheep equipment[4]	—	5	450.00	90.00
Tool shed	1	12	533.34	51.85
Total[5]			$7,685.69	$1,177.74

---

[1] *Agricultural Engineer Yearbook,* American Society of Agricultural Engineers, St. Joseph, Missouri, 1956 Edition, page 97.

[2] *Farm and Home Development Manual,* Extension Service, Storrs, Connecticut, January 1956, page 83.

[3] Barlow, F. D. Jr., and Fenske, L. J. *Cost and Utilization of Power and Equipment on Farms in the Mississippi River Delta Cotton Area of Louisiana,* La. Agri. Expt. Sta. Bul. No. 417, May 1947, page 44.

[4] Estimate.

[5] Excludes depreciation for fences because it varies for the different organizations. For the present and plan "C", depreciation is $20.83, plan "A", $78.66 and for plan "B", $50.86.

APPENDIX TABLE B-5.—Estimated Repair Cost for Present and Alternative Organizations

Item[1]	Age	Present	A	B	C
Tractor	5	$108.50	$108.50	$108.50	$108.50
Tractor disc plow	2	14.50	14.50	14.50	14.50
Busters	5	9.00	9.00	9.00	9.00
Cultivators, tractor	3	11.25	11.25	11.25	11.25
Stalk cutter	11	2.50	2.50	2.50	2.50
Planters	5	8.00	8.00	8.00	8.00
Distributor	1	3.00	3.00	3.00	3.00
Oat drill	10	7.50	7.50	7.50	7.50
Truck, 1½-ton	7	56.67	56.67	56.67	56.67
Trailer, small	2	14.69	14.69	14.69	14.69
Chick waterer	2	1.76	1.76	1.76	1.76
Chick feeders	2	8.94	8.94	8.94	8.94
Brooders	2	4.05	4.05	4.05	4.05
Broiler house	2	67.25	67.25	67.25	67.25
Hog equipment	1	—	—	19.25	—
Sheep equipment	1	—	9.00	—	—
Tool shed	5	15.85	15.85	15.85	15.85
Fence	—	9.37	35.40	22.89	9.37
Total		$342.83	$377.86	$376.30	$342.83

[1] *Handbook of Farm Management Information for Use in Balanced Farm and Home Planning,* Extension Service, Mississippi State College, Dec. 1953, Table 57. For truck, tractor, tractor equipment and poultry equipment, annual repair cost was estimated as 5 per cent of new cost, buildings 2 per cent, and fences 3 per cent of original cost.

APPENDIX TABLE B-6.—Cost of Fencing for Plan "A"

Item[1]	Unit	Amount	Price/Unit	Total Cost
Wire, 32-inch	roll	24	$18.00	$ 432.00
Barbed wire	roll	12	9.50	114.00
Staples	lbs.	85	.13	11.05
Posts	each	776	.40	310.40
Labor	hrs.	165.5	.50	82.75
Power	hrs.	161.1	.59	95.05
Total				$1,045.25

[1] Maisenhelder, L. C., McKnight, T. S. *Fences for Bottom Land Farms in the Delta,* Bulletin 483, May 1951, Mississippi Agricultural Experiment Station, State College, Miss.

APPENDIX TABLE B-7.—Cost of Fencing Farm for Plan "B"

Item	Unit	Amount	Price/Unit	Total cost
Wire, 32"	roll	15	$18.00	$270.00
Staples	lbs.	53	.13	6.89
Posts	each	156	.40	62.40
Labor	hrs.	103	.50	51.50
Power	hrs.	101	.59	59.59
Total				$450.38

APPENDIX TABLE B-8.—Estimated Depreciation and Repair of Buildings and Equipment, Present and Alternative Organizations

		Alternative		
Item	Present	A	B	C
		Depreciation		
Tractor	$180.84	$ 180.84	$ 180.84	$180.84
Tractor equipment	106.08	106.08	106.08	106.08
Truck	133.33	133.33	133.33	133.33
Broiler house	280.21	280.21	280.21	280.21
Broiler equipment	135.92	135.92	135.92	135.92
Tool shed	51.85	51.85	51.85	51.85
Hog equipment	—	—	—	—
Sheep equipment	—	90.00	—	—
Fences	20.83	78.66	50.86	20.83
Total	$909.06	$1,056.89	$1,138.60	$909.06
		Repair		
Tractor	$108.50	$108.50	$108.50	$108.50
Tractor equipment	70.44	70.44	70.44	70.44
Truck	56.67	56.67	56.67	56.67
Broiler house	67.25	67.25	67.25	67.25
Broiler equipment	14.75	14.75	14.75	14.75
Tool shed	15.85	15.85	15.85	15.85
Hog equipment	—	—	—	—
Sheep equipment	—	9.00	—	—
Fences	9.37	35.40	22.89	9.37
Total	$342.83	$377.86	$376.30	$342.83

APPENDIX TABLE B-9.—Labor and Power Requirements Used for Performing Various Operations[1]

Operation	Hours per Acre Once Over	
	Man	Power
Discing land	.50	.50
Harrowing	.45	.45
Seeding, drill	.30	.30
Fertilizing	.30	.30
Cultipacking	.49	.49
Bedding rows	.50	.50
Breaking land	2.00	2.00
Discing rows	.50	.50
Combining	1.20	1.20
Clipping pasture	.50	.50
Rebedding rows	.50	.50
Harrowing	.48	.48
Cultivating	.50	.50
Liming	.45	.45
Combining oats	1.42	.71
Mowing hay[2]	.58	.58
Hauling hay[3]	3.60	1.20
Raking hay[3]	.45	.45
Harvesting corn, hand[4]	8.20	2.10
Hauling oats	1.20	.60
Stalk cutting	.50	.50
Seeding	.30	.30
Sowing cover crops	.30	.30
Applying poison	.30	.30
Defoliating	.30	.30
Mechanical cotton harvesting	2.21	1.44
Hoeing cotton[5]	8.00	—
Harrowing	.32	.32
Planting	.60	.60
Fertilizing	.45	.45
Combining wheat[5]	1.30	.70
Hauling wheat[5]	1.20	.70
Turning under cover crop	.50	.50

---

[1] Bolton, Bill, and Lindsey, M. M. *Data for Farm Planning in the Delta Cotton Areas of Louisiana,* D.A.E. Circular No. 203, Louisiana Agricultural Experiment Station, May 1957, unless otherwise noted by footnotes.

[2] Fenske, L. J., and Barlow, F. D., Jr. *Tractors on Upland Farms in North Louisiana,* La. Bul. 309, Louisiana Agricultural Experiment Station, Nov. 1945, p. 15.

[3] *Reference Manual Farm and Home Development,* Louisiana Extension Service, Baton Rouge, Louisiana.

[4] Tramel, T. E., and Parvin, D. W. *Labor, Power and Equipment for Harvesting Feed and Forage Crops,* Bul. 547, Agricultural Experiment Station, State College, Mississippi, Dec. 1956, p. 5.

[5] Requirements obtained from farm operator.

APPENDIX TABLE B-10.—Prices Used in Present and Alternative Organizations

Item	Unit	Price[1]
Cotton seed	cwt.	$ 7.58
Oat seed	bu.	1.48
Corn seed, hybrid	bu.	11.60
Soybean seed	bu.	4.97
Lespedeza seed	cwt.	24.00
Vetch seed	cwt.	17.25
White clover seed	cwt.	85.60
Nitrate of soda	ton	65.60
Ammonium nitrate	ton	82.40
Superphosphate	ton	32.30
Lime	ton	6.50
Chicks	100	12.20
Broiler feed	cwt.	5.60
Cottonseed meal	cwt.	4.00
Protein supplement	cwt.	5.24
Pig starter	cwt.	5.50
Wheat seed[2]	bu.	3.25
Crimson clover seed[2]	cwt.	27.20
Dallis grass seed[2]	cwt.	87.00
Bermuda grass seed[2]	cwt.	52.00
3-12-12	ton	47.50
Steamed bone meal[2]	cwt.	3.50
Oystershell flour[2]	cwt.	1.25
Custom work		
Combining oats[3]	acre	7.50
Combining wheat[3]	acre	7.50
Combining soybeans[3]	acre	7.50
Shearing sheep[3]	hd.	.50
Benzene hexachloride[3]	lb.	.10
Boar[3]	hd.	90.00
Bred sow[3]	hd.	65.00
Ewe[3]	hd.	15.00
Ram[3]	hd.	30.00
Cotton defoliate[3]	lb.	.05
Wettable D.D.T. 50%[3]	lb.	.40
Muriate of potash[4]	ton	52.92
Stock salt[4]	cwt.	1.49
Choice calves[5]	cwt.	16.99
Ginning cotton[6]	bale	13.11
Butane gas[7]	gal.	.14
Pre-emerge[3]	gal.	20.00
Phenothiazine[8]	gal.	4.00
Gasoline	10 gal.	2.64
Oil[9]	5 gal.	5.20
Grease[9]	35 lbs.	5.95
Custom grind corn[10]	cwt.	.25
Mix feed[10]	cwt.	.10
Lespedeza hay	ton	26.40

(Continued on next page)

APPENDIX TABLE B-10. (Continued)

Item	Unit	Price[1]
Hauling chicks[11]	brood	10.00
Pick up broilers[11]	brood	20.00
Litter[12]	ton	6.50
Insecticide[12]	lb.	.13
Pre-mixed supplement[12]	cwt.	7.80
Machine harvest cotton[13]	bale	$10.00
5-10-5	ton	46.50
8-8-8	ton	56.40
Prices Received		
Soybeans[12]	bu.	1.95
Corn[12]	bu.	1.20
Oats	bu.	.86
Lambs	cwt.	17.05
Sheep	cwt.	7.32
Wool	lb.	.49
Cotton lint	lb.	.32
Cotton seed	lb.	50.99
Calves	cwt.	15.80
Calves, choice[5]	cwt.	17.63
Cows[5]	cwt.	10.73
Hogs[5]	cwt.	18.43
Sows[5]	cwt.	15.31
Wheat	bu.	2.25
Broilers[14]	lb.	.19

---

[1] *Agricultural Prices,* U.S.D.A. Agricultural Marketing Service, Crop Reporting Board. Prices are 5-year averages, 1953-1957, unless otherwise noted.

[2] Five-year average computed from Louisiana Agricultural Co-operative, Inc., Baton Rouge, Louisiana.

[3] Obtained from Franklin Parish County Agent's Office. These prices have prevailed for the past several years.

[4] *Agricultural Prices, Op. cit.,* U.S. 5-year average price.

[5] Five-year averages computed from Louisiana Weekly Summary Market Review, Louisiana Market Information Service.

[6] 1953-1956 average computed from *Supplement for 1957 to Statistics on Cotton and Related Data.* Statistical Bulletin No. 99, Agricultural Marketing Service, Washington, D. C.

[7] Winnsboro Butane Gas Company, Inc., Winnsboro, Louisiana.

[8] King's Feed and Seed Company, Winnsboro, Louisiana.

[9] Obtained from the bulk distributors in Winnsboro, Louisiana.

[10] Johnson Feed Mill, Chase, Louisiana.

[11] Obtained from farm operator.

[12] Estimated.

[13] Bolton, Bill, and Lindsey, M. M. *Data for Farm Planning in the Delta Cotton Areas of Louisiana.* D.A.E. Circular No. 203, Louisiana Agricultural Experiment Station, May 1957.

[14] Estimated. Five-year average price was 23.38 cents per pound. With increased production in Louisiana and throughout the South it was estimated that the price would decrease.

APPENDIX TABLE B-11.—Recommended Seeding Rates per Acre[1]

Crop	Unit	Alone	In Combination
		Per Acre	
Corn[2]			
Hybrid	lbs.	6-8	—
Open-pollinated	lbs.	8-10	—
Cotton[2]			
Solid-drilled	lbs.	30	—
Hill-dropped	lbs.	12-15	—
Check-planted	lbs.	20	—
Solid-drilled and check-plowed	lbs.	40	—
Oats[2]	bu.	3-5	—
Wheat[2]	lbs.	75	—
Rye[2]	lbs.	75	—
Pearl millet[2]			
Broadcast	lbs.	30-40	—
3-ft. rows	lbs.	10-12	—
Sudan grass[2]			
Broadcast	lbs.	25-30	—
3-ft. rows	lbs.	12-15	—
Vetch[2]			
Hairy	lbs.	20-25	—
Others	lbs.	30-35	—
Austrian winter peas[2]	lbs.	40-45	—
Singletary peas[2]			
Scarified	lbs.	30-40	—
Unscarified	lbs.	60-75	—
Cowpeas, alone[2]			
Rows	lbs.	30-60	—
Broadcast	lbs.	90-120	—
Lespedeza[3]	lbs.	30	20-25
Soybeans[4]	lbs.	45-60	—
White clover[5]	lbs.	6-8	4-6
Ladino clover[5]	lbs.	5	3
Crimson clover[5]	lbs.	15-20	—
Rye grass[5]	lbs.	25-40	15-20
Bermuda, common[5]	lbs.	5-8	5
Fescue grass[5]	lbs.	10	10
Red clover[5]	lbs.	10-15	—

[1] These are general recommendations. Seeding rates may vary from these general recommendations for a particular farm.

[2] Recommended by R. A. Wasson, Louisiana Agricultural Extension Service.

[3] [4] [5] Louisiana Extension Publications 1181, 1183 and 1037, by R. A. Wasson, A. G. Killgore and W. E. Monroe.

APPENDIX TABLE B-12.—General Fertilizer Recommendations[1]

Fertilizer	Cotton	Corn	Oats	Soybeans	Pastures
		Alluvial Soils			
N	60-100[2]	80-120[5]	45-60[6]	[7]	30-60[8]
P_2O_5	50[3]	—	—	—	[9]
K_2O	50-70[4]	—	—	—	[9]
		Terrace Soils			
N	50-60[10]	70-100	60-80[11]	12-20[12]	20-40[13]
P_2O_5	50-60	25-50	30-40	48-60	60-100[14]
K_2O	50-60	25-50	20 or more	40-48	60-100[14]

[1] Taken from *General Fertilizer Recommendations for Louisiana,* Circular No. 51, Louisiana Extension Service, Baton Rouge, Louisiana. For specific requirements, a soil sample should be taken.

[2] Nitrogen may be reduced when a good cover crop is grown.

[3] When soil is deficient in available soil phosphorus.

[4] When soil is deficient in potassium, 50-70 pounds N, 50 pounds P_2O_5 and 50-70 pounds of K_2O should be used.

[5] Can be applied as top-dressing or at the time of planting. On lighter alluvial soils use 70-100 pounds N, 25-50 pounds P_2O_5 and 25-50 pounds K_2O per acre.

[6] For grain only. On lighter alluvial soils use 60-80 pounds N, 30-40 pounds P_2O_5 and 20 or more pounds of K_2O per acre.

[7] Fertilizer usually not required on first bottom or alluvial soils.

[8] The application of 30-60 pounds N at or before planting and 30-60 pounds at two or more intervals.

[9] Some soils in the alluvial areas are low in available phosphorus and potassium. Soil test should be used to determine requirements of these nutrients.

[10] When initial application is less than 50 pounds of nitrogen per acre, additional nitrogen should be added as a top-dressing.

[11] When oats are for grain only.

[12] On heavier terrace soils use 42-64 pounds P_2O_5, 24-56 pounds K_2O.

[13] Fall or winter planted clover and grass mixtures. For extra grass growth 30-60 pounds nitrogen can be applied as a top-dressing one or more times.

[14] On established clover sod, 56-64 pounds of P_2O_5 and 32-56 pounds K_2O per acre can be applied.

MIDDLETON LIBRARY
DATE DUE

~~MAR [illegible]0 1985~~ X

~~AUG 1 7 1995~~ X

LOUISIANA STATE UNIVERSITY

LSU LIBRARIES
3 1518 084 217 524

S Louisiana Agricultural
67 Experiment Station. Bulletin.
E36
no.501-522

LOUISIANA STATE UNIVERSITY
TROY H. MIDDLETON LIBRARY
BATON ROUGE

Do not remove slip from pocket. In the event the book is returned without this slip, a penalty of $1.00 will be charged.

BOUND BY
HM